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Theorising in economics

"I view it as an ongoing attempt to bring some order into our thinking about economic phenomena and as the creation of a language in which these attempts can be discussed. I do not expect this activity to reach very many definite conclusions. I shall call the attempt at orderly thinking the attempt to understand."

Frank Hahn, Equilibrium and Macroeconomics, 1984, p.4

"Even accepting the criterion for realism, there is more to discuss: all theory is unrealistic; the question is in what way, and does that way matter?"

Victoria Chick, 'Order out of Chaos in Economics?' in: Sheila Dow and John Hillard (eds.), Keynes, Knowledge and Uncertainty, Aldershot: Edward Elgar, 1995, p.31

"...I suggest that we try to make sense of the world by imposing patterns on it, and then sticking to them as long as they are tolerably successful in allowing us to feel that we understand what we observe and what we experience."

Brian Loasby, Equilibrium and Evolution, 1991, p.6

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's-Gravenhage, 21 July 1998

Contents

1 Introduction

1.1 The topic of this book

This book aims at explaining the phenomenon of nominal price rigidity from the characteristics of a monetary economy. It thus aims at connecting the theory of money with the theory of value, albeit to a modest extent.[1] Formulating the research problem this way, implies three steps to be taken. Firstly, the question as to what exactly are the characteristics of a monetary economy has to be answered, as well as the questions as to what economists understand as money and how to conceive the impact of the use of money on an otherwise real economy. However, the latter question suggests that the only difference between a monetary and a real economy is the addition or exclusion of something called money. Instead, it will be argued that a monetary economy differs fundamentally from a real economy. Secondly, explanations of nominal price rigidity have to be studied in order to relate them to the monetary economy. Nominal price *rigidity* occurs when price setters in a market do not consider changing their prices profitable, given that other prices remain unchanged. In case all price setters share this view, the other prices do remain unchanged. By implication, the economy faces a fairly stable general price level. Prices do not react to changes in the monetary aggregate. The economy reacts to shocks mainly by making quantity adjustments, so that the level of production and employment is more volatile than the general price level. The term nominal price *stickiness* is used to refer to nominal prices which do not remain unchanged, but adjust slowly, so that present prices are influenced by historical rather than present factors. Unfortunately, most theories on nominal

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[1] The correspondence between the aim of this book and the more encompassing book by Patinkin (1956) goes well together with the resemblance of their titles. To a lesser extent, the same holds for the article by Townshend (1937), in which the concept of conventions plays as large a role as in the present book.

price rigidity take transactions in terms of nominal prices as no more than the exchange against the money value of commodities without considering the impact of the use of money on the functioning of the economy. Therefore, the third step needs to be taken in order to connect the two. The functioning of the monetary economy has become a topic of research itself instead of being a mere stepping stone in the process of developing the argument on nominal price rigidity. The fact that money is intrinsically different from other goods and that a monetary economy is fundamentally different from a standard textbook model economy has implications that reach beyond the problem of the neutrality of money. Historical time and fundamental uncertainty are determinants of a monetary economy (Davidson, 1978). They influence the way agents decide and the way all agents' decisions result in macroeconomic outcomes.

One of these outcomes is nominal price rigidity, or at least, nominal price stickiness. The way agents choose and act in an economy with historical time and fundamental uncertainty brings forth both the use of money and nominal price stickiness. Both are subject to conventional and institutionalized rules of behaviour that structure the interactions in the economy. In this sense, the two phenomena of money and nominal price rigidity are linked indirectly by the common sources of fundamental uncertainty and historical time. They are also linked directly by the argument that the stability of a monetary economy requires a stable price level in order to secure the purchasing power of money (Iwai, 1981, p.103 fn.13), and that nominal prices require a money as the unit in which they are expressed. Together, these direct and indirect links between the two phenomena that form the focus of this book can be visualised as 'a triangle in motion,' like the one at the cover. The triangle represents the interconnectedness of money, nominal prices, and their common source of the characteristics of a monetary economy, being fundamental uncertainty and historical time.

Generally, most of what is and will be said about nominal prices holds for nominal wages as well. For instance, the way conventions and institutions in price setting behaviour work out to stabilize the economy, has an analogy in

the existence of conventions and institutions that govern wage setting behaviour. The term 'nominal prices' can therefore be read as referring to nominal wages as well, unless wages or prices are discussed separately.

The present introductory chapter consists of the following parts. In the next section, a brief critical review of the literature on money and nominal price rigidity is given in order to provide a rationale for the study. The topic under study requires some methodological choices to be made, which are motivated in a separate section. Issues of terminology are left for later chapters. The last section gives an overview of the chapters of the book.

1.2 The economics of money and nominal price rigidity

In a Walrasian economy, the allocation is taken care of by an auctioneer. This construct has two implications for the economic world thus modelled. First, all agents have the information they need for executing buying and selling transactions, because the auctioneer supplies them with a set of relative prices, which determine the flows of goods. Second, time is irrelevant, because all trade is postponed until the auctioneer announces the vector of equilibrium prices, after which trade is assumed to take place and be completed instantaneously.

Strictly speaking, money is redundant in the Walrasian economy (Hahn, 1982, p.1). As in a planned economy, a central agency only has to announce the flows of trade which result in the equilibrium outcome. A medium of exchange is only necessary to bridge the gap between the seller and buyer of two commodities in case the process of exchange takes time. If it doesn't, there cannot be such thing as decentralized exchange, let alone the indirect exchange which characterizes a monetary economy.

Attempts to introduce money all suffer from an *ad hoc* character, because the utility of money then results from market imperfections which are added to the otherwise complete model (Goodhart, 1989, p.22). Most of macroeconomic theory fails to properly address the implications of monetary exchange for macroeconomic performance, at least insofar as formal models are

concerned (*cf.* Blanchard and Fischer, 1989, p.155). For instance, the function of a store of value cannot be rationalised as long as the store of value is only characterized by the fact that it is dominated by other assets in terms of interest revenue. True as this may be for interest rate dominance, the reverse holds true for liquidity dominance. The fact that the commodity which is most liquid tends to become the store of value is often neglected altogether, because this aspect is only relevant in situations of risk or fundamental uncertainty. In Chapter 17 of his General Theory, Keynes (1936) realized the impact of fundamental uncertainty by explicitly introducing the ratio of an asset's liquidity premium relative to its carrying costs, thereby enabling a modelling approach to the relative price of the store of value which also functions as the medium of exchange. Still, instead of pursuing this approach suggested by Keynes, most macroeconomic models start from an interest rate dominated store of value.

In addition, money is required to facilitate existing trades or allow for new ones, while the assumptions of perfect competition and complete information are maintained. The latter assumption explains why the liquidity premium of the asset chosen to be money is neglected, as the significance of such a premium is only derived from the use of money as a store of value in an economy with fundamental uncertainty. The former assumption rules out any intrinsic characteristics of the unit of account, since all traders are assumed to be price takers. Theories of nominal price rigidity must allow for price setting behaviour, as otherwise prices would adjust to changes in supply and demand (*cet. par.*). The assumptions of perfect competition and complete information also make the modelling of a medium of exchange very difficult, so that *ad hoc* assumptions like a cash-in-advance constraint or transactions costs[2] need to be invoked. All these added assumptions, from a dominant store of value in overlapping generations models to the transactions costs saving medium of exchange in search theoretic models are add-on's to a non-monetary economy,

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[2] To illustrate the *ad hocery*, besides the famous example of shoe leather costs, which are incurred by having to go to the bank every now and then, one can think of an even more ridiculous type of transaction costs: "the wear-and-tear on the fingertips of typing information into the ATMs" (Davidson, 1994, p.104).

so that money becomes the output of the model in the same way it was exogeneously put into it. The reason as to why money is used in its three functions is simply postulated by specifying the relative value it derives from facilitating exchange. As Davidson (1978) convincingly argues, this approach has little to do with the use of money by 'real people in the real world.' It leaves no room for identifying the impact the use of money has on pricing and exchange decisions, since price setting is incompatible with the assumed perfect competition and exchange is problematised and solved *ex ante*. Though many studies of nominal price rigidity relax the assumption of perfect competition, the relationship between the use of money and the behaviour of prices expressed in it cannot be studied if the basic assumptions of studies on money and nominal prices differ this much.[3] What is needed is an integrated treatment of both phenomena within one single paradigm. For instance, the effects of nominal prices on the perception of the value of commodities cannot be dealt with in neoclassical or New Keynesian models. In those models, agents are irrational if they do not take money as neutral. Also, the externalities involved in using money are not taken into account, because a choice theoretic approach to money is inadequate for dealing with the coordination problems that accompany its use.

Now what if money does matter to an extent that goes beyond the alternated version provided by the mainstream? The true challenge lies in finding an alternative to the theories criticized above, by which money and nominal prices can be treated within one paradigm. Useful starting points are given by the work of Keynes and Post Keynesian theory, the buffer stock theory of money, the theory of customer markets, and insights from institutional economics. For instance, the signalling function of nominal prices indicates that the unit of account in which they are expressed has more impact than only limiting the number of calculations to be made. A medium of exchange is not

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[3] For an example, compare the models on money in Chapter 4 with the New Keynesian models of nominal price rigidity in Chapter 8 of Blanchard and Fischer (1989).

deliberately chosen for its divisibility and low costs of carriage, but rather its use has emerged from an evolutionary process in which these two factors played a major, though not a decisive role. Interpreting the use of money as a convention enables a theory to deal with real world monies even though they may even be suboptimal from a transactions costs point of view. For example, the symbolic value of money, as the carrier of a nation's pride, cannot be expressed in terms of relative prices, although it does add a premium to a currency in the eyes of its holders, an aspect of money which has become clear in the process of monetary integration in the European Union. Another example is the utility that is attached to the stability of the general price level. If money is neutral, when all expectations are fulfilled, the price level does not matter. In case of an uncertain future, nominal prices provide information on which agents base their expectations, which in turn enable them to make decisions. Both a fluctuating price level and fluctuating individual prices hamper the formation of such expectations and thus limit the functioning of the monetary economy. In other words, a monetary economy calls for limited nominal price flexibility.

Although nominal price rigidity implies real price rigidity, the different causes of the two types of price rigidity call for separate theories. Roughly formulated, whereas real price rigidity calls for theorizing about the working of markets, nominal price rigidity has to take the use of money and nominal price setting behaviour into account. As for nominal price rigidity, most of the mainstream literature provides insufficient explanation. For example, it is no surprise that only quantity adjustments can result once price rigidities are imposed on a model, as is done in many New Keynesian theories. However, if one starts from a description of the economy that *inter alia* shows price rigidities, useful inferences may be made about the way the economy works. This criticism resembles the view on theories of money expressed above. Like money was added to an otherwise complete economy, so that it could not be of any use unless *ad hoc* assumptions were introduced, here, price rigidity is added to an otherwise perfect economy, so that outcomes cannot be more than second

best. By keeping the notion of equilibrium as a benchmark, the picture of the economy may differ substantially from an economy in which price rigidities serve a purpose of their own instead of hampering movements towards the equilibrium (*cf.* Hoogduin and Snippe, 1987, p.435). The benchmark of equilibrium implicitly assumes that markets would clear if only the impediments to price flexibility were not there. In turn, the assumed price rigidities call for *ad hoc* assumptions, such as the menu costs of changing prices. The assumed large impact of the costs of changing prices is hardly convincing, as is shown in empirical studies (*e.g.* Hall *et al.*, 1996) and can be seen in economies with hyperinflation (Davidson, 1994, p.303, fn.27). The assumption of price rigidities in a 'perfect' world is artificial, but price rigidities as such are not. Note that the use of the term 'perfect' and 'imperfect' also is a way of benchmarking, even if it may not intended to be so. This rhetoric is misleading, because it suggests that Keynesian economics is a mere special case of the neoclassical model, instead of being fundamentally different (Davidson, 1994, p.292). As a result of taking the equilibrium as a benchmark, the assumed deviation of prices from the equilibrium level cannot be justified, so that the selection of specific rationing rules cannot be but arbitrary. However, empirical research offers better explanations for nominal price rigidities than a search for 'optimal' behaviour in an inappropriate economic model would deliver. Research as done by Blinder (1991a, 1991b) and the Bank of England (Hall *et al.*, 1996) delivered insights in actual nominal price setting behaviour and will be discussed in chapter three. To sum up, acknowledging and explaining the existence of nominal price and wage rigidities is something different from postulating them.

Research of the 1980's started from market imperfections and tried to see whether price rigidities could be the outcome of optimal behaviour under this assumption. This is an improvement, since now a possible cause of price rigidities is investigated. Still, however, the benchmarks of clearing markets and optimization were retained, and the limited success of this exercise may be blamed to those features of the approach. Most of the theories from the 1980's are captured under the heading of New Keynesian economics, because they try

to derive the so-called 'Keynesian' results of price and wage rigidity from models which are to a large extent neoclassical. In other theories, the same results follow from a different approach. For instance, in Post Keynesian economics, perfect competition is not the benchmark, as usually the focus is not on the concept of markets. Prices that serve other purposes besides equilibrating supply and demand, like marketing literature and the theory of mark-up pricing indicate, show different behaviour from prices that are supposed only to restore equilibrium. They are also more likely not to result in a movement of the general price level, as marketing considerations differ among products and sectors. Institutions and other norms govern price setting behaviour as well.

This sketchy enumeration of elements of an alternative approach to nominal prices indicates that the monetary economy is to be conceptualized quite differently from the Walrasian approach. Several authors contributed to building alternative frameworks, which can be grouped in three categories. The first group analyses a Walrasian economy with decentralized price setting, that is, without the auctioneer. The results by Iwai (1981) are particularly interesting for the purpose of studying nominal price rigidities in such a framework, so they will be discussed extensively below (see chapter 6). The second group focuses on coordination problems and will be discussed earlier (see chapter 4). As coordination problems abound in a monetary economy, the seminal article by Cooper and John (1988) on coordination failures provides a starting point. Both the first and the second category of research maintain as much as possible of the neoclassical model, only amending it by excluding the auctioneer and introducing imperfect competition in order to allow for price setting behaviour. The third group of literature stems from Post Keynesians and (Neo) Austrians, who have in common that they think in terms of Keynes' idea of a monetary theory of production or value by which money plays an essential role in the contracting for goods and labour. As argued above, such a perspective can only be considered in the context of historical time when aspects of the future may be fundamentally uncertain. The third approach is relevant for the study of money and price rigidity, because money and price rigidity can both be

interpreted as ways of dealing with uncertainty. All three approaches are complementary steps in the argument of this book.

This ends the introductory discussion on existing models of money and nominal price rigidity with a few preliminary conclusions. Any theoretical framework which is to properly analyse the essential characteristics of a monetary economy and their impact on nominal price flexibility, must dismiss the general equilbrium approach in which competitive markets and flexible prices are a benchmark. As will become clear in the following chapters, the impact of uncertainty and historical time is too drastic to simply add or leave some features while remaining within the paradigm of the neoclassical model. Instead, heterodox[4] theory provides an alternative conceptualization of the monetary economy which is suitable for analysing nominal price rigidity.

1.3 Methodology and other general remarks

In a monetary economy, the goods markets and labour market cannot be assumed to always clear,[5] so that there may be buyers or sellers who are disappointed. Individuals can be (instrumentally) rational in that they optimize in every transaction, but they face uncertainty while making their transaction decisions. In case information is lacking, they have to decide on the basis of expectations. Sometimes they may decide not to transact at all, because they will be rationed at their reservation transaction price, or they prefer to wait until an attractive trading opportunity appears. By implication, a buffer stock of goods needs to be held as well in order to allow for spending of the buffer stock of money (Kuipers, 1991, p.129; Laidler, 1990, p.9). Therefore, although individuals may be rational and act upon their information or expectations, it

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[4] The term 'heterodox' refers to non-mainstream or non-orthodox strands of theorizing, such as Post Keynesian, Austrian, and institutional economics.

[5] It can even be argued that the concept of markets is not ontologically relevant in a monetary economy, as it cannot deal with movements in output and employment as a whole, which are essential to the study of macroeconomics (Rotheim, 1996).

is highly unlikely that the result will be a competitive equilibrium outcome, which is to say that markets are not likely to be cleared. This makes the notion of such an equilibrium less useful as a benchmark for understanding the workings of the monetary economy. Rather, the concept of stability is relevant, in particular price level stability, because it facilitates the formation of expectations concerning the future (Rotheim, 1993, pp.203, 206).

A monetary economy can be more or less stable, both in terms of fluctuations in output and employment and in terms of price level stability. One of the main themes of this book is the contention that the conventions and institutions with regard to the use of money and their impact on nominal wage and price setting behaviour contribute to stability of the economy, *i.e.*, the absence of inflationary or deflationary tendencies. This contention itself is not new, but the analysis of the way they do so, as well as the implications for the economic system, aims to contrive the development of these ideas. The concept of ranges of stability combines the benefits of stability and flexibility, because small shocks are absorbed within the existing structure of conventions and institutions, whereas the aggregate of agents manages to handle fundamental shocks by adjusting the structure of the economy, that is, the way the economy is organized.

By analogy to the difference between the idea of a unique equilibrium (or a few of such points) and the idea of a range of stability, a distinction can be drawn with regard to economic behaviour. Whereas the neoclassical model assumes its agents to be instrumentally rational, that is, to show optimizing behaviour in order to reach the highest attainable outcome, agents in a monetary economy may have good reasons to not always strive for maximal immediate profit or utility, because these may go at the expense of other valuable factors, such as long-term trading relationships. In other words, behaving instrumentally rational is not always the sensible thing to do. As a research strategy, the assumption of instrumental rationality is taken as a starting point and therefore as a benchmark in order to separate the impact of characteristics of the agents from characteristics of the economy they live in. This point deserves particular attention when coordination problems are

present. As such, it is related to the question as to the appropriateness of methodological individualism. Coordination problems occur in situations in which the results of individual actions depend on the actions of other individuals, so that individuals are interdependent in determining their optimal strategy. Agents are interdependent with regard to the formation of expectations concerning other agents' behaviour as well. Then, coordinating on patterns of actions may be more profitable than showing maximising behaviour in every single transaction, because expectations can be formed more accurately. Methodological individualism, by taking the individual as the decision making entity and neglecting feedback of the aggregate upon the individual, is inappropriate for analysing coordination problems (*cf.* Garretsen, 1992, p.10). Thus, the characteristic of the economy, with coordination problems following from uncertainty and the interdependency of pay-offs of actions, may determine the type of rationality of the agents as well as the theoretical approach taken. This line of thought results in analysing firstly the characteristics of the monetary economy, secondly the nominal price setting behaviour of economic agents within such economy and thirdly the effects of this behaviour on the efficiency and stability of the economy as a whole (*cf.* Janssen, 1993, fig.2.3).

A related issue is the standpoint taken with respect to the micro foundations debate. The third step above can be interpreted in terms of a micro foundation of the macro economy, to the extent that the aggregate outcome is underpinned from individual choice theoretic behaviour. At the same time, however, the second step implies a macro foundation of micro behaviour. Individual behaviour is not only determined by a utility function to be maximised within the context of an economy which constrains the individual, it also constitutes the economy by its interaction with behaviour of others. The importance of the coordination problem in the monetary economy has such influence on individual behaviour, that a macro foundation of micro behaviour is warranted (*cf.* Garretsen, 1992, p.10). Fortunately, the two ways of underpinning economic behaviour are not mutually exclusive. Rather, the individual and the economic system presuppose the other, as is exemplified by

Keynes, who did not fall prey to the fallacy of composition while writing his General Theory (*ibid.*,1992, p.10). This view on economic theorizing gains support from the conception of macroeconomics as the economics of the coordination problem, as opposed the microeconomic problem of allocation (Van Ees and Garretsen, 1990, p.124). However, more interpretations of the distinction between micro and macroeconomics are possible (Janssen, 1993) and may as well be consistent with the above arguments for a two-way approach. To sum up, the explanation of nominal prices from the characteristics of a monetary economy invokes both an analysis of microeconomic behaviour and an analysis of its macroeconomic results as well as an examination of the two-way relation between the two.

The research strategy chosen for structuring the argument is as follows. In chapters two through four, the method of decreasing abstraction is used. The highly abstract Arrow-Debreu model of a static general equilibrium economy is taken as a starting point for deriving the minimal prerequisites for a theory of money. A similar approach is taken to nominal price rigidities, by discussing theories which take an economy with perfect competition as a benchmark. The method of decreasing abstraction is chosen because it clearly identifies the amendments to mainstream economics needed in order to deal with the phenomena at hand, and because it simultaneously allows for a critical review of these theories. The degree of abstraction is lowered explicitly in the treatment of coordination problems, by starting from a formal game theoretic approach and then introducing notions from institutional economics. After this deductive stage, an inductive stage follows, in which the theoretical material thus gathered is applied to actual economies in chapters five and six on trust and stability. Though realism is often wrongly confused with empiricism, realism of the theory is aimed for by connecting the theory as much as possible with real-world phenomena in terms of stylized facts. Chapter seven on stability of systems is of an even more inductive character and again has a high degree of abstraction because of its meta-economic approach in which economic systems are interpreted from natural systems theory.

1.4 Outline

The argument of this book focuses on identifying the characteristics of a monetary economy and their implications on nominal price setting behaviour, so that an explanantion for nominal price rigidities from the use of money is derived. The critical review of theories on money and nominal prices discussed above is extended in the next two chapters.

Chapter 2 scrutinizes theories of money by starting from an Arrow-Debreu economy in which money is irrelevant. Then, a critical discussion of several (pseudo-)monetary models follows. The three functions of money are taken as criteria for assessing the adequacy of these models in terms of incorporating and explaining the use of money. The models that are discussed can be divided into three groups. The first group consists of static and dynamic general equilibrium models. The Arrow-Debreu model and the Walrasian metaphor of the auctioneer form the static part of the group, and the temporary equilibrium model as well as the overlapping generations model comprise the dynamic part of the group. The second group contains the general equilibrium search theory. This type of general equilibrium models is dealt with separately, because it focusses on the coordination function of money by explicitly modelling the way a medium of exchange facilitates the search process. As such, search theoretic models are the most sophisticated general equilibrium models of money. However, it is argued that they do not endogenise the use of money, as they postulate the existence of one commodity with the lowest, or zero, transaction costs. The third group of models consists of alternative explanations for money, which all start from fundamental uncertainty. The theory of the credit economy, the buffer stock theory of money, and the Post Keynesian theory all derive complementary implications of this assumption. The role of historical time becomes meaningful as well, because it refers to the impossibility of undoing transactions, which increases the impact of uncertainty on transaction decisions. At the end of the chapter, it is concluded that fundamental uncertainty and historical time are prerequisites for a monetary economy.

In **chapter 3**, several types of theories about nominal price rigidity are

discussed. Starting from the benchmark of competitive markets, additional assumptions must be made in order to allow for price setting instead of price taking behaviour. New Keynesian theories of nominal price rigidity all assume imperfect competition, but retain the assumption of instrumental rationality in terms of profit maximizing behaviour. From this framework, the rationality of not always adjusting prices to changed circumstances can be defended by making a cost-benefit analysis of price changes. Some of these theories only deal with individual price setting decisions, such as the menu-cost approach, while others incorporate coordination issues, like the theories on multiple equilibria in price setting. Theories on coordination problems assume that information concerning the behaviour of other agents may be lacking instead of, or in addition to, the lack of information on market variables which is allowed for in many models of individual price setting behaviour. The benchmark of perfect competition is dismissed in theories on cost-based pricing and mark-up pricing. The theories take the impact of imperfect competition more seriously by studying the impact of the market structure on pricing decisions. The same holds for the theory of administered prices. In these theories, the fact that suppliers may choose to set their prices on the basis of other factors than demand imply that quantity rationing may occur. Prices serve other purposes than equilibrating supply and demand, such as covering the costs of production or keeping up a market structure. In this sense, they can be seen as facilitating the coordination of price setting decisions. Nominal price rigidity can then be appreciated, which would be impossible in case the benchmark of perfect competition with market equilibrium was maintained. Other, less formal theories build upon this line of thought. It can be argued that prices support relations between buyers and sellers, as in customer markets as well as in industry buyer-supplier relations. Likewise, prices can be seen as carriers of information concerning the intentions of transactors. In the real world, notions of fairness and trust play a more important role in price setting than formal models allow for.

This brings the argument to the phenomenon of coordination problems, which is scrutinized in **chapter 4**. It starts with a formal game-theoretic

interpretation of coordination problems that occur in an economy. Three types of games are discussed, in which the degree of coordination versus conflict varies. It is shown that game-theoretic techniques for equilibrium selection or securing the highest pay-off outcome do not always suffice, which raises the need for exogenous information. Even if agents know everything except the actions of others, the coordination problem cannot always be solved. Norms, such as conventions and institutions, may provide this information. The emergence and persistence of norms as well as the relationship between the type of game and the type of norm are discussed. Here, an evolutionary approach to norms for behaviour comes in, which is applicable to a monetary economy because of the assumption of historical time. Norms are rules of behaviour, which can take the form of conventions and institutions, depending on whether or not compliance is voluntary or enforced. This distinction parallels that of informal and formal norms also found in the literature. The relationship between conventions and rationality is discussed, whereby the concept of instrumental rationality is replaced by that of procedural rationality. Institutional economics complements the formal treatment of norms for behaviour, because it analyses institutions from a transactions costs as well as a behavioural point of view. The tree of institutional economics has many branches, and an eclectic approach allows for choosing the notions which are useful for building up the argument. The combination of game theory and institutional economics provides a framework in which conventions and institutions can be seen as devices for solving the coordination problems that follow from uncertainty. The convention of using money and the institutions surrounding it as well as conventions and institutions concerning nominal price setting structure the interaction between individual agents, so that transactions are facilitated.

A related concept is trust, which plays a role in many kinds of economic relations. Trust and habits fall outside the concept of rationality, but support the functioning of conventions and institutions. Habits are relatively easily incorporated into the theoretic framework, because repeated behaviour already is part of the evolutionary approach taken in the former chapter. The concept

of trust deserves separate attention and is dealt with in **chapter 5**. In this chapter the impact of trust on economic relations, particularly monetary transactions relations, is scrutinzed. An exploration of the concept of trust is given, in order to narrow down the notion to its essentialities. It turns out that two aspects of trust are important: an information aspect and a normative aspect, and that the impact of trust can be analysed at two levels: the bilateral level and the societal level. Both levels are relevant for analysing the use of money and nominal price setting behaviour. The informational aspect is most easily compatible with existing economic theory. Here, trust can be seen as partly complementary to and partly substitutable for information, as a subjective source of additional information, so to say. However, this approach is incomplete: if agents know that they can trust one another to cheat, they may have a lot of information but the economy performs worse as compared to an economy in which agents can trust one another to behave honestly and cooperatively. In terms of coordination games, the high level coordinated outcome comes within reach once members of an economy share a set of ethical values: norms for behaviour that were seen to be crucial in chapter 4. Further, if the level of trust is high in an economy, agents dare to take more risks, thereby lowering the transaction costs which go together with aiming for complete contracts. So, this chapter supports the outcomes of chapter four. Shared ethical values both provide a focal point in pure coordination games and prevent defective behaviour in conflict games.

In **chapter 6**, the insights of the former chapters are taken together by coming back to the main question as to the explanation of nominal price rigidities in a monetary economy. The existence of both uncertainty and historical time in a monetary economy brings forth coordination problems with regard to the exchange process and price setting decisions. It is argued that these problems are solved in two complementary ways, namely top-down and bottom-up. Most literature on price level stability only studies top-down coordination, by institutions such as a central bank or a government. However, this form of regulation is insufficient and very costly if it is to achieve price level stability on its own. Fortunately, the decentralized actions by which agents deal

with the uncertainty they face contribute to coordination and may have the unintentional beneficiary effect of contributing to stability as well. Conventions and institutions are created, either intendedly or unintendedly. For instance, agents turn to implicit and explicit contracts and somehow agree to adjust quantities instead of prices. The role of trust becomes visible once pricing conventions such as 'fair' prices are taken into consideration. This form of coordination makes the economy more stable than standard economic models predict. As was seen in pure coordination games as well, real agents do better than their modelled counterparts. This effect of unpredicted stability is possible because money fulfills a specific role as a carrier of information which supports norms for behaviour. The fact that agents calculate in terms of money becomes meaningful once the implication that they also communicate in these terms is taken seriously. This results in a model of a monetary economy which is entirely different from the Walrasian economy with money as the '*n*-th good' the analysis started with. Not only is the quantity of the store of value relevant, but its quality as the most liquid asset is also relevant. The Keynesian vision of entrepreneur economy is thus underpinned by adding the analysis of the conventions and institutions that play a stabilizing role in it. Coordinative strategies at the individual level have a stabilizing effect that can be seen as an unintended consequence of these actions which thus are beneficial for the economy as a whole.

Though the research question is answered by now, more can be said about the role of conventions and institutions in stabilizing the monetary economy. In **chapter 7**, the corridor approach by Leijonhufvud (1981) is a starting point for studying the concept of stability. The term stability refers to equilibria, which are a phenomenon common in closed systems. An open system approach shows that a system can self-organize. As open systems are studied in the natural sciences, the possibility of using some of the concepts used therein for analysing the monetary economy is explored. Traditionally, science had it that systems in nature are subject to the entropy law, which creates a homogeneous, chaotic state. From the theory of dissipative structures, which originates from Nobel laureate Ilya Prigogine (Prigogine and Stengers,

1985), the insight is gained that a barrier to entropy exists. Once an open system has reached a certain level of entropy, it starts to self-organize by creating patterns of behaviour and interaction of the individual units of the system. Analoguously to chemical processes, which are in fact a series of interactions between molecules, an economy can be modelled as a self-organising system of interacting agents. Moreover, it can be argued that an open system can only self-organize *thanks to* historical time and uncertainty. This view is radically different from the neoclassical view, in which an economy can at best be stable *in spite of* these two characteristics. The dissipative structures in chemistry are characterised by a high degree of order inside the structure, that is, they locally reduce the degree of entropy. The same can be said about conventions and institutions. These rules for behaviour structure the way agents interact so that the economy finds itself in a state of order. Stability can then occur in a higher level sense, that is, the economy is robust to shocks: it can restructure itself after shocks have disrupted old structures. In restructuring the economy, the evolution of new conventions and institutions plays a major role.

Chapter 8 concludes the book by taking stock of the insights gained from the argument and reviewing the issue of nominal price rigidity in a monetary economy.

2 Theories of Money

2.1 Introduction

Several theories aim to explain the existence and use of money in an economy. In this chapter, they are discussed by way of decreasing abstraction. The chapter starts with a description of the Arrow-Debreu model of an economy, in which money is redundant. By relaxing the strict assumptions the model makes, particularly the assumptions concerning time and information, a rationalization for the use of money can be given. Efficiency arguments underpin the combination of the three functions of a medium of exchange, a unit of account and a store of value in one medium. A description of a monetary economy results, which is characterized by historical time and uncertainty, and transaction costs which result from these.

A monetary economy is commonly defined as an economy with indirect exchange. The medium which enables the exchange to be indirect is called the medium of exchange. Money can then be defined as the commonly accepted medium of exchange (*cf.* Wärneryd, 1989). A distinction can be made between money as a medium of exchange and money as a means of payment, the latter being a subset of the former. While a medium of exchange allows a transaction to proceed, a claim to future payment remains on the paying party or on a third party. A means of payment finalizes the transaction so that no such claim remains. The transfer of a means of payment makes an end to a debtor-creditor relationship, whereas the transfer of a medium of exchange does not. This implies that many forms of IOU's can serve as a medium of exchange, but not as a means of payment (Goodhart, 1989, p.26). In case of transactions on a credit basis, the function of a medium of exchange is not accompanied by the function of a means of payment, whereas in case of uncertainty concerning the creditworthiness of transactors, money must also serve as a means of payment (Goodhart, 1989, pp.26-27). As (fundamental)

uncertainty will be shown to be intrinsic to a monetary economy, money needs to be commonly accepted as a means of payment, as well. Therefore, in the remainder of this book, the term medium of exchange refers to the two functions together. The fact that money must be a means of payment does not imply that it should be of a fiduciary character. In other words, the money used for indirect exchange in a monetary economy can be either commodity money or a fiat money backed by a (central) bank. Cuadras-Morató (1994) theoretically explores the possibility of an ice cream money and concludes that storeability of the good used as money is relevant, but not crucial. Instead, the general and costless acceptance of money, *i.e.* its liquidity, is essential. Besides facilitating indirect exchange, money is also used as a unit of account and a store of value. The unit of account function reduces the number of relative prices, so that trading invokes less calculation costs. Money is kept as a store of value because of uncertainty, which makes agents want to absorb shocks by keeping buffer stocks of it or use it for speculative purposes (Kuipers, 1991, p.128). The combination of the three functions in one asset contributes to money's functioning, as it reinforces its liquidity.

The use of money in facilitating exchange is most commonly observed. The nineteenth century's economists Jevons and Menger defined money as any object that serves as a generally acceptable medium of exchange (Grossman, 1991, p.323). Monetary, or indirect, exchange is distinguished from barter exchange by the splitting up of the trading process in two separate actions, the first being the sale of a good against money and the second being the purchase of a good with the money. "The object which thus temporarily intervenes in sale and purchase is money" (Jevons, 1875, p.55). Although money can also function as a unit of account and as a store of value, it is its role of a medium of exchange in indirect exchange transactions that most clearly distinguishes money from other assets, at least in classical and neoclassical theories. Keynes emphasized that money is distinguished from other assets because of its high degree of liquidity (1936, Ch.17), which makes it attractive as a store of value. If transaction costs are taken into account, money's high degree of liquidity also makes it attractive as a medium of exchange, as in the theory by Brunner and

Meltzer to be discussed below.

The chapter is organized as follows. Section two starts by describing general equilibrium models. The Arrow-Debreu model is used as a point of reference in order to clarify the limited compatibility of general equilibrium economics with money. Amendments to the Arrow-Debreu model which incorporate the functions of money are also assessed. In the third section on general equilibrium search models, the matching of transactors on a market and the use of a medium of exchange are formalized. Section four deals with explanations of the use of money that are not based on the general equilibrium paradigm. This section deals with Post-Keynesian theory, the Austrian theory of money, the theory of buffer stocks and the credit approach to money. The last section summarizes the chapter and gives an intermediate assessment of the characteristics of a monetary economy thus derived.

2.2 General Equilibrium Theory

An equilibrium is defined as a situation in which no agent has an incentive to make changes, unless exogenous shocks occur. This definition implies that an equilibrium needs not be Pareto-optimal, and that equilibria can occur both at high and at low levels of output and employment. An economy is in a state of Walrasian or general equilibrium if a price vector exists such that there is no good for which there is positive excess demand (Varian, 1984, p.316). By Walras' law, if demand equals supply in all markets but one, demand will equal supply in this one market as well. By the first theorem of welfare economics, a Walrasian equilibrium is Pareto efficient (*ibid.*, p.326). A general equilibrium can then be described as a state in which all individual markets and all decision making units are in simultaneous equilibrium so that each market is cleared at a non-negative relative price vector, with each consumer maximizing utility and each producer maximizing profit. The term competitive equilibrium, which has the same connotation, emphasizes the contribution of markets to achieving the market clearing price vector. As said above, a general equilibrium is characterized by its Pareto-superiority over other equilibria or disequilibrium

situations. The Pareto-efficient outcome is achieved by means of perfect competition on all markets as well as common knowledge of the equilibrium vector of prices and quantities. By definition, the medium of exchange has a price of one, but this price is not related to demand and supply on the market for money. It can even be argued that money does not have a market of its own, as money is used as the medium of exchange in all the other markets in the economy (Iwai, 1996, p.475). The inference that money does not fit well in the general equilibrium model is scrutinized in the next few sections.

General equilibrium theory analyses the nature of general equilibria and the prices that prevail in these situations. In neoclassical economics several kinds of general equilibrium models have been developed. These models vary according to the assumptions made with respect to the decision-maker's environment and the equilibrium generating mechanism. The discussion of general equilibrium theory starts with the Arrow-Debreu model. Subsequently, its restrictions are relaxed in order to investigate whether money can play a role.

2.2.1 The Walrasian Auctioneer and the Arrow-Debreu Model

In the Walrasian equilibrium model the world can be described as consisting of many suppliers and demanders plus one auctioneer. There are as many markets as there are commodities and factors of production. For each market there is a supply function, a demand function and a 'market-clearing condition,' which dictates the quantities demanded to equal the quantities supplied. The idea of *tatônnement* by way of prices being cried out at markets was raised by Léon Walras (1938, pp.56-57, 210-111, and p.268). In later literature, reference is made to a 'Walrasian auctioneer,' although Walras does not explicitly introduce the concept of an auctioneer. Following the literature, in this book the auctioneer is also referred to as such. The Walrasian auctioneer performs two functions. The first function, which is called the allocative function, is to quote prices in such a way that the general equilibrium is attained. During the *tatônnement* (groping) process, the announcement of prices by the auctioneer

and the communication of the notional demand and supply quantities at these prices by producers and consumers alternate until the equilibrium prices are found (Hahn, 1989, p.63). The process of finding the equilibrium prices must take at least an infinitely small period of time in order to make the notion of prices relevant. At the other hand, it occurs relatively fast as compared to the rate of change of the capital stock (Bliss, 1975, p.313; Ostroy, 1989, p.191). No factors are traded before the equilibrium price vector is found, that is, there is no trade against disequilibrium prices (Arrow and Hahn, 1971, pp.264-266). Still, the *tatônnement* process does not always converge to an equilibrium.[1] In 1954 Arrow and Debreu added some severe restrictions to show that in a perfectly competitive economy the general equilibrium secures an efficient allocation of the commodities and the factors of production. An economy which satisfies the many restrictions Arrow and Debreu imposed on their model in order to derive this efficiency result has been called an Arrow-Debreu economy since. One of these severe restrictions is the assumption of a complete set of perfectly competitive markets. The second function of the auctioneer is to bring together suppliers and demanders so that they can execute their trades. This function is referred to as the coordination function. Its essence is the transfer of information to the market participants about the intended actions of their trading partners. A remarkable feature of the Arrow-Debreu model is that although the execution of transactions can be thought of as decentralized thanks to the common knowledge of the relative prices, still, a centralized auctioneer is necessary for coordinating it (*cf.* Iwai, 1981, p.8).

When the Arrow-Debreu model is compared with the general equilibrium models that will be discussed later, three of its characteristics stand out. Firstly, the *tatônnement* process is assumed to take place in an infinitely short interval so that equilibrium is attained immediately after the demand and supply conditions are known. This feature gives the model a static character. Secondly, the auctioneer is assumed to be perfectly informed about the demand

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[1] "The adjustment process cannot be shown to converge to its stationary solution [...] indefinite oscillation is a possible outcome." (Bliss, 1975, p.313 ff).

and supply conditions in all markets at the prices he announces in order to be able to perform his task of finding equilibrium prices. All other market participants are assumed to know the relative prices announced by the auctioneer so that they can determine their demand and supply quantities. However, they only know whom to trade with, because the auctioneer has informed them. Finally, both the acquisition of information and the execution of transactions can be realized costlessly. The static character of the model, the assumption of perfect information, and the absence of information and transaction costs will turn out to be of decisive influence on the presence or absence of a role for money in the Arrow-Debreu model.

2.2.2 Money in Static General Equilibrium Models

A money functions as a generally acceptable medium of exchange. Besides, it is also used as a unit of account[2] and as a store of value. In the Arrow-Debreu model, however, there is no need for a medium of exchange nor for a unit of account whereas other commodities provide better services as a store of value. This implies that money has no function so that the existence of money cannot be explained by the model. A separate discussion of each function will underpin this argument. It reveals that the two assumptions of less than perfect information and the existence of transaction costs are necessary for rationalizing the use of money. This implies that only the static character of the Arrow-Debreu model remains intact, while the context will change with regard to the other two assumptions.

Money as a Medium of Exchange

The clearing of the market and the allocation of goods is taken care of by the auctioneer and occurs instantaneously. This implies that the exchange of goods

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[2] Niehans prefers the use of the term "medium of account" above the term "unit of account", because money itself is not a unit. It is a unit of money which is used as a device for accounting. The choice to adhere to the conventional term of "unit of account" is not meant to deny Niehans' point (1978, p.118).

is direct, so there is no need of an intermediate asset which functions as a medium of exchange. The execution of transactions can be visualized as an instant in which all sellers bring their supply to a central meeting point, followed by a next instant in which all buyers take out the type and amount of commodities they demanded at the relative prices announced. Alternatively, a central planner announces the vector of equilibrium prices and the exchange is executed in a decentralized manner, which will take time as well. Still, however, thinking in terms of two instants of time already implies a relaxation of the rigorous assumptions underlying the Arrow-Debreu model. So, if the medium of exchange function of money is to play a role, a theory of decentralized, time-consuming exchange is needed.

In order to allow for a medium of exchange in a general equilibrium model, the auctioneer must be dismissed. By means of a medium of exchange, agents themselves can take care of investigating demand and supply conditions as well as facilitating the execution of transactions. When the auctioneer no longer takes care of the matching of potential buyers and sellers, the exchange of goods will occur in a decentralized manner. Having to find each other, traders are forced to incur information and transaction costs.[3] In other words, the assumptions of perfect information and of costless transactions must be dismissed. Further, a theory of exchange has to deal with two aspects of exchange: the finding of trading partners and the actual exchange. In general equilibrium search theory, the problem of matching trading partners in a system of decentralized exchange is explicitly modelled, while the selection of a medium of exchange is circumvented by postulating a commodity with low transaction costs. General equilibrium search models are discussed in the next section. Here, the focus is on the coordination problem involved in the selection of a commodity that serves as a medium of exchange. Both in the finding of

[3] In this context the distinction between information and transaction costs is a bit superfluous as both follow from the absence of perfect information. For an analysis of this point, the reader is referred to Goodhart (1989, pp.28-29). In the following, the term transaction costs is meant to cover both information costs and other transaction costs.

opposite trades and in the trade itself, transaction costs are involved. By implication, a general equilibrium may not be reached, because transaction costs may prohibit marginal adjustments of the allocation. Still, an equilibrium outcome is possible in the sense that no agent wishes to make further transactions.

The introduction of transaction costs provides an explanation of the use of money as a medium of exchange (Niehans, 1969). In Brunner (1971) and Brunner and Meltzer (1971), the argument runs as follows. An agent who owns an endowment of goods wants to exchange this for another bundle of goods. In a world without transaction costs, the agent will acquire all the information he needs in order to be able to exchange his endowment for his desired terminal bundle of goods. However, if there are transaction costs, part of the endowment is spent on acquiring information about exchange ratios, *i.e.* relative prices, and about the quality of goods available at the market. Therefore, he must divide his endowment into a part to be spent on the production of information and a part to be exchanged. The process of exchange can follow two ways. Firstly, the agent can try to find another agent who has exactly the opposite position with regard to the endowment and the desired terminal bundle. The need to find such a trading partner is called the double coincidence of wants problem.[4] Secondly, the agent can choose a chain of indirect exchanges. The more information the agent possesses, the more he is able to use an efficient chain of transactions, that is, with favourable exchange ratios, and purchase goods which increase his utility. These welfare improving effects of having information can be set against the welfare losses of the costs of information production, for example, the time spent on acquiring information. The optimizing agent will allocate exactly that part of his endowment to the production of information that equals the welfare gains to the welfare losses. However, an infinite regress problem arises, since agents cannot know the value of information unless they have information about it. Therefore, it is

[4] If the existence of time is also taken into account, the agent has to solve the problem of a double coincidence of timing of those wants as well (Goodhart, 1989, p.2).

difficult for agents to optimize their purchases of information if they do not have all the information (*cf.* Hoogduin and Snippe, 1987, p.436). More can be said by taking a closer look at the chains of transaction. Brunner and Meltzer assume, firstly, that the marginal cost of information depends on both the information level and the good, while, secondly, this cost is, for a given level of information, evenly distributed among the agents in the economy and, thirdly, declines as the frequency with which the good is used for exchange increases. As a consequence of these assumptions, the agent will be better off by choosing to exchange for goods with low information costs during the intermediate transactions. This behaviour saves information costs and, because of this, enables the agent to devote a larger part of his endowment to exchange so that he will end up in a better terminal position (*cf.* Alchian, 1977). A few transaction chains will turn out to be optimal. The goods that are involved in these chains because of their low transaction costs are called transaction dominating assets. Since the information costs were assumed to be evenly distributed among the agents in the economy, the preference for transaction dominating assets is commonly shared among the agents. According to the third assumption the agents will choose a small number of goods for exchange in order to enjoy the decline of the marginal costs as the usage intensity increases. This completes the explanation by Brunner and Meltzer of the existence of a few transaction dominating assets or commodity monies by the introduction of information costs in an economy with optimizing agents. Still, the selection of one particular commodity as the commonly accepted medium of exchange remains to be explained. This selection cannot be modelled as an individual decision, since it invokes a coordination problem.

Money as a Unit of Account

A unit of account is a good in terms of which prices are quoted, accounts are kept and whose own unit price is one by definition. In a world with imperfect information about trade opportunities it can be used by potential traders to compare prices of either different goods or the same good offered by different suppliers. However, in the Arrow-Debreu model the need to compare prices is

eliminated because it is the Walrasian auctioneer who decides on the equilibrium price for every good. At the moment these prices are announced traders execute their transactions by trading goods against goods. For the traders only quantity adjustments are relevant, which implies that they in fact use relative prices. It is only the auctioneer who may want to calculate in terms of nominal prices, that is, in terms of money as a unit of account. If he does, the suppliers and demanders need to state their supply and demand functions in terms of the unit of account. However, any other commodity can provide this service of a unit of account equally well as money can. The commodity that, if it is used as a unit of account, will incur the lowest accounting costs will be chosen as the unit of account. This commodity is likely to be, but needs not be, fiat money (Niehans, 1978, p.123). To conclude, the Walrasian economy can do without a unit of account and if it wants to use one, every commodity can serve as such.

The monies discussed in the former section are no more than a medium of exchange, which makes the transaction costs approach by Brunner and Meltzer a partial explanation. The authors are aware of the fact that they identify money with the medium of exchange and, what is more, they mention the possible advantages of using one good both as a medium of exchange and as a unit of account (Brunner and Meltzer, 1971, p.803 and p.787, respectively). Their explanation of the existence of a unit of account is, as they say, "analogous to the gain that comes from introducing a common unit of measure such as height, weight or temperature." In a barter economy without transaction costs and with n commodities $n(n-1)/2$ relative prices exist. By using one commodity as a unit of account the amount of prices can be reduced to n. Introducing a unit of account thus lowers accounting costs. However, this reduction of the accounting costs only holds if the unit of account is also used as a medium of exchange (Niehans, 1978, p.121). A money which only functions as the unit of account cannot be uniquely determined nor rationalized from the Arrow-Debreu model. Since only relative prices play a role, the *numéraire* is arbitrary. This implies that the unit of account has no intrinsic characteristics. Any item that satisfies the minimal prerequisite of divisibility can function as

such, and even this requirement is not always satisfied, as the use of heavy stone wheels at the Island of Yap illustrates (Mankiw, 1992, pp.144-145).

Money as a Store of Value

After the discussions of the functions of money as a medium of exchange and as a unit of account, attention is paid to money's third function. If money is used because it contains purchasing power, then it functions as a store of value. The fact that a store of value is redundant in the instantaneous exchange process implies that no criteria can be derived for a commodity to serve as a store of value. The liquidity of goods is of limited importance, since all demand can be satisfied at the going relative prices. All relevant information is present, so that there is no need to wait for a next opportunity to trade. In a world without perfect information, it can be rational for people to hold money if they are uncertain about the rate of return on other assets. Still, the rate of return on money is lower than on any other asset because it does not yield interest.[5] Therefore, it is rather difficult to find a reason as to why a store of value might exist in a world with perfectly informed decision makers or a complete set of spot and future markets, as in the Arrow-Debreu model, because it seems irrational to hold money in that situation. In order to make the use of money as a store of value an outcome of the model, modifications need to be made. Blanchard and Fischer (1989, Chapter 4) discuss three of them that have been suggested in the literature.

The first one consists of putting money directly in the production function or the utility function. Money is thus interpreted as a production factor or a source of utility *per se*. The latter has been put forward by Sidrauski, who put real money balances directly into the utility function. Households maximize their expected lifetime utility, subject to their budget constraint. The expected lifetime utility of households is derived from consumption as well as from the

[5] Money's rate of return can become higher than that of other assets if the prices of the other assets fall or in a situation of deflation. Occasions of these are few, so they do not undermine the present argument. However, the overlapping generations models discussed below build upon such situations.

real money balances they hold. The constrained maximization leads households to choose a combination of money holding and consumption such that the marginal rate of substitution between consumption and real money balances is equal to the nominal interest rate, which can then be interpreted as the price of money services (*ibid.*, p.190). By putting money in the utility function of households, it is assumed that money is of value to them. Then, the outcome that households do hold money conforms to expectations, but does not contribute to explaining behaviour. Until the utility of money is underpinned, the Sidrauski model will be no more than a shortcut and of little use for the purpose of explaining the use of money as a store of value (*cf.* Hahn, 1982, p.2). The same holds for the work by Patinkin, who argued that people can have a taste for real money balances besides one for goods.[9] He considered the absolute price level as the one monetary variable in the otherwise real economy (Patinkin, 1956, p.105). Agents suffer from money illusion if their excess demand functions for commodities "do not depend solely on relative prices, real income, and real balances" (*ibid.*, p.23). Patinkin observed that money illusion is inherent to any money economy (*ibid.*, p.109). By implication, money and nominal prices do influence the excess demand functions of individuals, so that it can be inferred that these are arguments in their utility functions. A suggestion for underpinning the utility of money in an economy with transaction costs has been put forward by Brunner and Meltzer (Brunner, 1971, p.19 and Brunner and Meltzer, 1971, pp.803-804). As was set out above, these authors argued that money as a medium of exchange enables an agent to enjoy more real opportunities of transforming his endowment into a terminal consumption bundle and so to increase his utility. According to their view this may justify the incorporation of money as an argument of the utility function.

The second way to make the use of money as a store of value an outcome of the model is even more directly based on imposing money on the model. Moreover, the store of value is assumed to be the medium of exchange

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[9] In the second edition of *Money, Interest, and Prices*, Patinkin tried to rationalize including money in the utility function by an analysis of money as a means of exchange in a stochastic payment process (Patinkin, 1965, pp.82-88).

as well. According to the so-called legal restrictions approach, money is held only because citizens are forced to hold it by legal tender laws. If these laws were absent, people would choose to hold interest-bearing assets. However, this theory does not provide an explanation for the making of those laws by a government. The problem of explaining the use of money is only transformed into the problem of explaining the making of legal tender laws. Even if the advantages of seigniorage induce a government to issue legal tender laws, the explanation does not hold in case the government's interest is the same as that of its citizens. Moreover, although money has been related to the state since coinage emerged, other forms of money preceded the state system (Hicks, 1969, p.63). Apart from these criticisms, there are several comments that can be made on the legal restrictions approach as has been done by Wärneryd (1989). Firstly, if transaction costs are taken into account, it can be argued that money, for example in the form of currency, does yield a kind of interest because it facilitates exchanges. Secondly, the comparative advantage of interest-yielding assets like bonds is reduced by their higher transaction costs, that is, the costs of converting them into money. Thirdly, the use of a commonly accepted medium of exchange depends on convention which is itself subject to externalities. This implies that agents, while selecting a particular medium of exchange, do not only take into account the interest yield associated with money and other assets, but also solve the coordination problem involved in together choosing one asset as their commonly accepted medium of exchange. By the connection between the store of value function and the medium of exchange function because of transaction costs, the same argument holds for money as a store of value. In other words, there is a coordination problem involved in the selection of a store of value once this asset is transferred as such and may be even stored in a bank. The legal restrictions approach more or less assumes this choice is made by a central institution, while Wärneryd supports an evolutionary explanation of the choice process as has been given by Menger. The Menger theory is dealt with in section four on the Austrian School. To sum up, the legal restriction approach not only does not contribute to explaining the use of money as a store of value, it can be criticized on several grounds as well.

The third theoretical construction for incorporating money as a store of value in the Arrow-Debreu model has been developed by Clower (1967) and is known as the cash-in-advance constraint. It is interesting to note that Clower, without any further explanation, assumes real balances to be an argument in the utility function of each agent. He then observes that his quite common definition of the optimization problem in terms of the above-mentioned utility function and a budget constraint is not sufficient for explaining a distinctive role for money in an economy. To arrive at a result in which "money matters," Clower starts by defining money as a commodity that can be traded directly for all other commodities in the economy. This implies that a monetary economy is distinct from a barter economy because in a monetary economy not all commodities can be used as money, that is, as a medium of exchange. Then, to formalize this idea, he adds a restriction on the transactions technology: transaction costs are infinite for any market exchange that does not involve the use of money as a means of payment. This restriction has become known in the formulation Clower chose: "Money buys goods and goods buy money; but goods do not buy goods." It can be incorporated in the optimization problem by dividing the budget constraint into an expenditure constraint, in which money is sold for goods, and an income constraint, in which goods are sold for money. In this way the total value of goods demanded is made sure not to exceed the amount of money available to the transactor: the cash-in-advance constraint. The approach suffers from the same deficiency as the previous two modifications did, namely the imposition of the use of money on the model in order to derive the use of money by transacting agents in an Arrow-Debreu economy. Moreover, money's possible use as a store of value stems from its function as a medium of exchange, so that no separate explanation for money as a store of value is provided. However, the purpose of Clower's article was not to explain the use of money as such but to provide an analysis of the workings of a monetary economy. Therefore, to the extent that the two can be separated, the cash-in-advance approach cannot be criticized, but it remains of little use for the present purpose. Summarizing the discussion on the three approaches, it can be concluded that it is difficult to derive the use of money as

a store of value from a neoclassical model without imposing restrictions on it that already assume what has to be explained.

Interim Conclusion

Before continuing the discussion on general equilibrium models of money by switching to dynamic versions of it, the discussion is reviewed, here. For the purpose of explaining the use of money, three of the assumptions of the Arrow-Debreu model are particularly relevant, namely its static character, the availability of perfect information and the absence of transaction and information costs. Attempts to incorporate money into the model were discussed by looking at the three functions money performs in an economy. In order to give a rationale for the use of money, the last two assumptions had to be dismissed. After this was done, the use of money as a medium of exchange and as a unit of account could be explained. However, without making additional *ad hoc* assumptions, the use of money as a store of value could not follow from the model. Only if the store of value is connected to the medium of exchange and the exchange process is assumed to take time, a store of value can be rationalized. Then, the model no longer has a static character. In the next section, the first assumption of the Arrow-Debreu model will be dismissed as well, so that two dynamic general equilibrium models can be scrutinized. This will contribute to explaining the role of money as a store of value.

2.2.3 Money in Dynamic General Equilibrium Models

In general equilibrium models, a complete set of future and contingent markets is assumed to exist. In fact, these models are static, because all relevant information is present and the future is determined by present transactions. Once uncertainty exists and the set of markets is incomplete, the future may differ from the present in an unknown fashion. Then, the model becomes dynamic (*cf.* Van Ees, 1990. pp.17-18). Following Hicks, in a static model an economy is in equilibrium if "certain key variables (the quantities of commodities that are produced and consumed, and the prices at which they are

exchanged) are unchanging" while a dynamic model takes these variables as changing, so that "dynamic theory is the analysis of the processes by which they are changing" (Hicks, 1965, p.6). Dynamic models contain periods which can be linked by the existence of stock quantities, by expectations, and by optimization procedures which cover a range of periods. For the purpose of connecting time periods in temporary equilibrium models and overlapping generations models, these links are used in different ways. In static temporary equilibrium models, stock quantities and expectations are given or determined by history, so that periods can be analysed separately, whereas in sequential analytic temporary equilibrium models, the adjustment of stock quantities and expectations connects time periods, so that developments over time can be analysed. In overlapping generations models, intertemporal utility maximization and the use of stock quantities provide the dynamics.

2.2.3.1 The Temporary Equilibrium Model

In 1939,[7] two authors presented a temporary equilibrium model: Hicks wrote on period analysis and Lindahl on the sequential method. Both analyses have in common that they introduce time into general equilibrium models. They take time to be divided in periods and postulate a mechanism to connect the periods. In essence, the two methods are comparative static in kind, as adjustments between the periods do not take time, so that the market process is not analysed (Van Ees, 1990, p.120).

The sequence analysis by Lindahl allows for trading at all periods, which is desirable because the set of markets is not complete. Lindahl distinguishes two kinds of temporary equilibria (1939, pp.65-66). In the temporary equilibrium in the first sense, the market price is adjusted to the demand and supply factors as they appear currently in the market. A temporary equilibrium in the second sense allows for interdependence between prices and the supply and demand functions during the period. Here, prices in

[7] The part of Lindahl's book which deals with his model was already published in Swedish in 1930, but appeared in a translation to English in 1939 (Lindahl, 1939, p.9).

period t determine income in period t, which influences the demand and supply as of period $t+1$, which together determine the prices as of period $t+1$. The dynamics of the model consist of transitions from one equilibrium to another, which, by its abruptness, can be considered rather unrealistic (*ibid.*, p.69). The prices are equilibrium prices because they equate supply and demand during the period (*ibid.*, p.159).

In the period approach by Hicks, time is introduced by creating a sequence of periods in which markets are in equilibrium. A notion often used in this context is that of the 'Hicksian week', which is defined as "that period of time during which variations in prices can be neglected" (Hicks, 1939, p.122). On 'Monday' the markets are open so that transactions can be agreed upon, while on the other days the contracts are carried out. From 'Tuesday to Sunday' markets are closed and the economy is supposed to be in equilibrium (*ibid.*, pp.122-123). Adjustments are assumed to be made between periods, while within periods prices do not change. The economy is in temporary equilibrium if the condition of a static equilibrium cited above holds, while an intertemporal equilibrium requires both "equilibrium at every point in time within the period" and the point-of-time equilibrium expectations "must be consistent with one another and with what actually happens within the period" (Hicks, 1965, p.24).

The adjustments between periods can take place because of two reasons. Firstly, the expectations agents hold at the beginning of a period can be different from the expectations they held at the beginning of the previous period, because their former expectations were disappointed or because new information has become available.[8] Secondly, adjustments can take place because agents may have ended the former period with stocks of goods so that they start this period with endowments that differ from the endowments they held at the start of the previous period.

With respect to the formation of expectations the temporary

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[8] The expectations held are price expectations, although Hicks also sees a possibility for incorporating price-quantity expectations in an imperfectly competitive economy (Hicks, 1965, p.72).

equilibrium approach can again be divided into two lines of thought. In the sequential analytic approach by Lindahl, expectations are determined by experience in previous periods. As they emerge from history, they are independent to the present. The temporary equilibrium approach by Hicks contends that expectations are influenced by current experience. As the expectations are formed at the same moment as the one in which the variables that influence the expectations take their values, the analysis becomes of a 'quasi-static' character (Hicks, 1965, p.66). The Lindahl approach provides for a link between periods, whereas in the Hicks approach expectations cannot serve as such. Therefore, in the temporary equilibrium approach there is need for a so-called continuation theory that describes how periods are linked without being based on expectations. This theory is based on the secondly mentioned reason for adjusting between periods, namely the existence of stock quantities, such as investments.

One of these stock quantities can be money, which then serves as a store of value. As agents are uncertain about the future periods, they may prefer to hold money instead of other assets that presumably give a higher yield. Though this provides room for a store of value, it does not determine the commodity that is used as such, which is a problem that also occurred in static equilibrium models with a store of value. In temporal equilibrium models money also functions as a unit of account for contracting transactions. As a medium of exchange it facilitates the execution of transactions. From this it can be concluded that in temporary equilibrium models, as opposed to static equilibrium models, allow for money in its three functions. However, as the models were not designed to study money, they do not contribute to explaining its characteristics or its use in a monetary economy. In fact, there is nothing essentially monetary in temporary equilibrium models.

2.2.3.2 *Overlapping Generations Models*

Another class of general equilibrium models in which time explicitly plays a role consists of overlapping generations models. The term overlapping generations refers to the idea that people in these models all live for a few

periods of time, so that at every moment more generations are alive: the older people of the previous generations and the younger people of the current generation. All people of all generations live an equal number of periods. For a short description of a simple overlapping two-generations model Blanchard and Fischer (1989, Chapter 4) and Weddepohl (1990) will be followed. At birth the young persons receive an endowment of one unit of a commodity per person. As this is their only source of living, they have to divide this endowment into two parts, of which one is to be consumed immediately, while the value of the other part can be saved until the next period. The way consumers divide their endowment depends on their utility function, of which their rate of time preference forms a part. The endowment is assumed to be perishable, which induces the young to sell the part they do not consume in the first half of their lives to the old in exchange for money. When they are old, they use this money to buy goods from the then young. The model can be extended in various ways, for instance, by the introduction of extra generations, an intergenerational bequest motive, a productive storage technology, and endowments in other life-cycle periods besides the first one. Here the focus is on the use of money in the context of overlapping generations.

The introduction of money is a way to deal with intertemporal utility maximization. It is assumed that in period zero the old are given a fixed amount of paper money, which is the only asset in this economy. This fiat money will be accepted by the young as long as they trust they can exchange it for goods when being old. This implies that the assumption of the economy going on forever is a necessary condition for fiat money to be of value in an economy. Another condition for money to be of value, which is at least as relevant, is the assumption that money is the only asset in the economy.[9] If there were other assets with a higher rate of return than money, people would prefer

[9] Although three period overlapping generations models exist in which two assets are distinguished, which differ in their degrees of liquidity and, inversely related to this, their rates of return, still, the store of value function of money follows from the assumptions concerning its characteristics rather than from choice theoretic behaviour by the money using agents.

to hold these assets instead of money. A comparable problem occurred earlier in the section on money as a store of value and in the discussion of temporary equilibrium models. In fact, overlapping generations models only deal with the transfer of purchasing power within and between generations without determining which asset will function as a medium of transference, let alone explaining why money might function as such. Goodhart even states that there is no need to spend much time on overlapping generations models as these throw more light on life cycle savings than on monetary phenomena proper (1989, p.23). In the model nothing more is done than introducing a store of value and, because there is only one store of value, forcing the economic agents to hold that one asset. It can be shown, as has been done by Blanchard and Fischer (1989), that, if the barter equilibrium did not already happen to be a Pareto optimum, the use of a store of value may bring the economy from the barter equilibrium to a Pareto optimum. This can be a well-founded motive for incorporating a store of value in an intergenerational model. However, in the model, the value of money is derived from its function as a medium of exchange. Therefore, without a theory of exchange, there is no indication that money will be used as a store of value. The overlapping generations framework thus cannot serve as an independent underpinning for the use of money.[10] It suffices from the same deficiencies as did the static models with a store of value discussed above, namely the imposition of the 'money' on agents who then have but one choice left.

From temporary equilibrium analysis as well as overlapping generations models, it can be concluded that the existence of time in a model

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[10] It is possible to construct overlapping generations models with self-fulfilling expectations. In these models the economic agents incorporate the value of a certain variable in their expectations formation. This behaviour may lead to a situation in which this variable influences the steady-state situation simply because agents expect it to do so. In the economic literature such a variable is called a sunspot variable, because sunspots have been used as an example of a variable that may influence an economy even while no direct link from sunspots to economic variables exists. An interesting option may be the possibility to create overlapping generations models in which money is a sunspot variable (see for instance Grandmont, 1989). However, these models do not help explaining the existence of money, because it is imposed on the model as an exogenous variable without any explanation of why it is used.

makes the use of a store of value efficient. On the other hand, no reason still can be given as to why commodity money or fiat money should be used for transferring purchasing power from one time period, or one generation, to the next. In the part of section four on Post-Keynesian economics it will turn out that the concept of time that is used up till now, partly explains the lack of determination. While the concept of logical, reversible time in this section on dynamic general equilibrium models does not suffice for explaining the use of money, the concept of historical time will do, as will be explained below. Before that, in the next section, general equilibrium search models are discussed, in which money is used as a medium of exchange.

2.3 General Equilibrium Search Theory

A mutual intention of at least two agents to trade with each other is a primary condition for a medium of exchange to be used. The problem of how potential trading partners find each other is treated in search theory. Search theoretic models can be used for analysing coordination issues which, for instance, arise on the market for labour and the market for goods, because the exchange process is modelled explicitly. As such, it attempts at providing a microfoundation for the macroeconomic phenomenon of coordination failure (Van de Klundert, 1987, p.468). Thus, search theory can be used to analyse the medium of exchange function of money by showing the conditions for a medium of exchange to evolve.

The description by Brunner and Meltzer of the searching for the optimal chain of transactions discussed above can be seen as a starting point for search theory. The search process itself has been elegantly modelled by Diamond (1982, 1984a, 1984b). Diamond's analysis starts from an economy with many agents and one homogeneous good, which cannot be produced as well as consumed by the same agent. In other words, the good has to be exchanged before it can be consumed. This feature makes the agents producers, traders and consumers in turn. Because there is only one good, the trading is on a one for one basis, implying that all relative prices are one, although this latter

formulation is rather artificial in a one-good world. This restriction on the behaviour of the economic agents in the Diamond economy ensures the occurrence of exchange transactions without complicating the model by introducing more goods. The trading process is characterized by a trading externality and a feedback mechanism, which work as follows. The trading externality occurs when people increase their stock of produced goods which are available for trade. The greater the stock of goods available, the easier it is for potential traders to find a trading partner. Therefore, the chance of meeting a trading partner is modelled as an increasing function of the level of inventories. The feedback mechanism is connected with this externality: "...increased production for inventory makes trade easier; easier trade makes production for inventory more profitable and therefore justifies its increase" (Diamond, 1984b, p.5). A low activity steady state, with low inventory levels and only a few transactions, and a high activity steady state, with high inventories and many transactions, are equally likely to be the outcome of the model. The possible existence of multiple stable equilibria is caused by the combination of the trading externality and the positive feedback mechanism.

The Diamond search model is a barter model, because the one good is traded against itself. In order to account for money the model would have to be extended, firstly by allowing for indirect exchange between at least three parties and, secondly, by incorporating at least two more goods, so that one good can function as commodity money and at least two goods can be traded and consumed. Strictly speaking, one non-monetary good would be sufficient if accompanied by a trade restriction as in the one-good economy above, but this restriction makes the items of the good different in the eyes of the consumers, so that the good is heterogeneous, which boils down to two goods being traded. As Clower (1967) explains, a money economy needs at least three goods, because a two-good economy is a barter economy, a three-good economy is either a barter economy or a pure money economy, and an economy with four or more goods can be either a pure money economy or a non-pure money economy. In a pure money economy only one specific commodity can be traded for any other commodity, whereas in a non-pure money economy a fraction of

the goods can be traded directly against each other while the other goods can only be traded against the commodity money. In both kinds of a money economy the exchange transaction can be dichotomized so that it satisfies the cash-in-advance constraint, which makes it possible for people to trade goods against money and money against goods. In a money economy nominal prices, that is, prices in terms of money, exist alongside relative prices, that is, prices in terms of other goods. By comparing these nominal and relative prices agents can reduce their transaction costs just as they do in the aforementioned model by Brunner and Meltzer.

A model of indirect exchange is developed in Kiyotaki and Wright (1990). In this model a continuum of commodities for consumption exists, each with its own utility for every agent, as well as an object with zero direct utility, which is called fiat money. The trading process is made subject to the restriction that a trader who accepts a consumption good incurs a 'transaction cost,' measured as an amount of utility, while a trader who accepts money does not lose utility.[11] The absence of transaction costs for the latter trader is the rationale behind the use of money: it gives money an indirect utility. Production as well as transactions are stochastic (Poisson) processes: the agents find production opportunities and meet potential trading partners with constant arrival rates. The probability of agreeing on a transaction depends on these arrival rates as well as on the strategies of the potential trading partners. When agents agree on a transaction, they exchange their inventories one-for-one. This exchange ratio implies that nominal as well as relative prices are one. In equilibrium all agents solve their maximization problems, given the strategies of others and the meeting probabilities, and consistent with their rational expectations. An equilibrium can be of a pure monetary, mixed monetary, and non-monetary kind, depending on the probability of money to be accepted by traders. The mixed-monetary economy denotes the same as the non-pure money economy in Diamond's model, as in both terminologies an economy is denoted in which

[11] A medium of exchange may even emerge in case transaction costs are equal for all commodities, money included. Then, agents will use money because others do so as well, so that a bootstrap equilibrium results (Iwai, 1996).

some trades are direct and others aren't. This implies that there are at least four goods. In fact, Kiyotaki and Wright assume a "continuum of differentiated goods" (1990, p.4). When the probability of money to be accepted by traders is less than one, barter trade still exists, which implies that the "double coincidence of wants problem" is not solved entirely.

Though search theory contributes to modelling the matching problem in an exchange economy, it does not solve all theoretical problems involved. Two issues of criticism can be raised here. Firstly, the probability of accepting of the money commodity is assumed to be known to all agents. By translating the search problem into a dynamic programming problem and solving this in a rational expectations equilibrium, it is implicitly assumed that the probability that money is accepted is common knowledge among the agents. Unfortunately, assuming the probability that money is accepted to be known is begging the question, because this assumption circumvents the coordination problem involved. At the one hand, a higher rate of acceptance lowers transaction costs of the commodity used as money as it becomes more liquid. At the other hand, the probability of acceptance increases, the lower these transaction costs are. This circle of causality causes multiple equilibria, in which the probability of accepting money is different. Coordinating upon the acceptance of a medium of exchange is different from coordinating upon the commodity which is to serve as money. The two coordination problems are related to the extent that the selection of a medium of exchange depends on transaction costs. In other words, assuming the probability of acceptance to be given implies assuming a coordination problem to be solved. Secondly, the assumption that transaction costs are lowest for a given commodity breaks through the above circle argument, but does so at the expense of assuming another issue which has to be explained. The rationale for using money in a search equilibrium model is the same as in the Brunner and Meltzer model. In both models it is the asset with the lowest transaction costs that is used as a medium of exchange. In a sense, the models are complementary. Brunner and Meltzer describe the emergence of a few transaction dominating assets and

endogenize a medium of exchange by doing so. Opposed to this, in search theory, a medium of exchange is imposed on the model by postulating an asset with zero transaction costs so that the transactions which are facilitated by it can be analysed. The contribution of search theory consists of illuminating the matching process that takes place before transactions can be executed. Thereby, the work has enlarged the insight in the performance of a barter economy with direct exchange as opposed to a monetary economy with indirect exchange. Still, the introduction of a Clower-like dichotomization of the exchange process is only a tool for the introduction of money, not an explanation of it. According to Kiyotaki and Wright (1990, p.18) the use of money leads to an increase in specialization and productivity because the increased marketability of goods in a monetary economy more than offsets the reduction in marketability by specialisation. However, even though this may address an important advantage of the use of money, it does not explain how money comes to be used. In fact, Iwai (1996) acknowledges this problem which is also apparent in his search-theoretic model. As he understands it, money is used by members of an economy for the very reason that other members use and accept it as well. This bootstrap mechanism sustains a monetary equilibrium once it is established, but does not explain the evolution of a barter economy towards a monetary one, a change that can only occur by a large disturbance of the barter equilibrium. Moreover, it does not indicate which commodity is selected as the medium of exchange, particularly in case transactions costs are endogenous. For analysing the coordination problem involved in selecting a medium of exchange, other theories are necessary, which will be discussed in chapter 4. To sum up, even if general equilibrium search theory can provide an *ex post* rationalization of the use of money, an explanation of the evolutionary process towards monetary exchange cannot be given.

As for the two other functions of money, they are difficult to analyse within the search theoretic framework because money is only characterized by its low transaction costs, regardless of whether these are endogenous or exogenous (*cf.* Van Ees and Garretsen, 1995, p.279). Only one search

equilibrium model deals with the unit of account function by analysing the impact of the price formation assumption on the results of the model. Trejos and Wright (1993) comment on earlier written search theoretic articles that the impact of monetary policy in the models described may hinge on the fix-price assumption. For instance, they wonder whether the welfare results of an increase in the money supply in the model by Kiyotaki and Wright would be as large if prices would be determined endogeneously. Trejos and Wright improve the state of the art by explicitly modelling the price formation process as a bilateral bargain between potential trading partners. In equilibrium the output level is too low to equate marginal costs to marginal utility, a result that goes together with too high a price level. The reason for this to occur is that sellers discount the money they receive by their rate of time preference and therefore supply less than they would have supplied in case they had not discounted the future. A continued increase in the supply of money leads to a higher output which gets accompanied by a price level increase. This implies that welfare first rises and then lowers as the inflationary effect overrules quantity effects. The authors admit that these results also depend on the model, but perhaps not in a crucial sense, namely to the degree that the amount of money directly relates to the ratio of buyers to sellers. For the purpose of analysing the unit of account function, this is less relevant. What does matter, however, is the modelling of decisions as being made in terms of commodities. The trading partners calculate in terms of goods and money has no utility of its own. The fact that prices are set in terms of it does not increase its value, and only the impact of price level changes is analysed, not of changes in individual prices. To sum up, the price formation process itself is not underpinned, only its outcome is taken into account.

The function of money as a store of value is not analysed in search equilibrium models. This does not imply that it does not play a role. After all, the model is dynamic. Money enables the economy to reach a high level outcome because it allows agents to wait without incurring costs other than those following from their time preference until a trading opportunity arrives. This implies that the money itself does not perish, so that its purchasing power

remains intact, as long as prices remain unchanged.

All in all, the advantages of search equilibrium models are not found in their underpinning of the use of money, but in formalizing the exchange process. This makes them useful for analysing labour market problems as well, because at the labour market, the problem of matching is essential. The dynamic character of search equilibrium models, as well as the introduction of transaction costs for non-monetary goods resulted in the use of a medium of exchange. However, for the present purpose, they only provide limited insight into money's function as a medium of exchange. This ends the discussion on general equilibrium models. Different approaches are now discussed, in which the assumptions of timelessness, perfect information and zero transaction costs are replaced by historical, irreversible time, fundamental uncertainty and positive transaction costs.

2.4 Theories of Risk and Uncertainty

The concept of uncertainty plays an important role in alternative explanations for money. The term is used differently by several authors, so that a specification is warranted. Mainstream authors focus on transaction costs and risk because these concepts are more tangible than uncertainty. Opposed to this, Post-Keynesian authors put emphasis on transaction costs while suggesting that these follow from uncertainty. Hoogduin (1991, pp.28-29) describes the view on uncertainty developed by Knight, who distinguishes between risk and uncertainty. In a situation of risk one can measure a probability. A probability distribution can be calculated, from which an expected value and a certainty equivalent can be derived so that one can hedge against the risk. Although a certainty equivalent is not the same as certainty, the situation of risk is compatible with general equilibrium models, as long as the need for information on the probability distribution is taken into account. In a situation of uncertainty it is impossible to define all possible states of events, let alone attach numerical probabilities to them. One can only give a subjective view on the future, whereas in case of risk an objective probability distribution, that is,

a probability judgement which is independent of the agent who makes it, can be given (*cf.* Hoogduin, 1991, p.23). Therefore, hedging against uncertainty is impossible. In the literature this connotation of uncertainty has been given the name of 'uncertainty in the sense of Knight' in order to distinguish it from other notions of uncertainty. Some authors call it 'fundamental uncertainty' or 'genuine uncertainty,' while using the term 'uncertainty' for a situation of risk. Although his description of uncertainty differs significantly from the one used by Keynes, it is sometimes referred to as 'uncertainty in the Knight/Keynes sense' (Hoogduin, 1991, p.31 ff). Here, the terminology devised by Knight will be followed, so that risk and (fundamental) uncertainty are contrasted.

By the introduction of uncertainty into the analysis, the context changes drastically. From an analytical point of view, a difficulty arises. At the one hand, a monetary economy is compared to a nonmonetary economy, while at the other hand an economy with perfect foresight is compared to an economy with fundamental uncertainty. If the decentralized monetary economy is supposed to exist in an uncertain world, while the nonmonetary economy is assumed to be of the Walrasian type, then the comparison loses its meaning, because the effect of the use of money cannot be distinguished from the effects of uncertainty and the auctioneer, respectively. Then, the *ceteris paribus* clause does not hold. If, on the other hand, the monetary as well as the nonmonetary economy have to cope with uncertainty without the aid of a Walrasian auctioneer, then the comparison might easily favour the monetary economy, because of the advantages of indirect exchange, and the saving on storage costs of money as opposed to goods. This is exactly what can be observed in real world economies, which have to take uncertainty as given: they are all monetized. The exercise performed in this chapter thus compares the theoretical construct of a nonmonetary economy with perfect foresight with a stylized model of the real world monetary economy under uncertainty.

2.4.1 Credit

The name of Hicks is often associated with the IS/LM model, which came forth

from the interpretation Hicks gave of Keynes' "General Theory of Employment" in his 1937 article "Mr. Keynes and the Classics". However, in the IS/LM model the use of money is postulated, so this model is not suitable for explaining the use of money. In other parts of his work on monetary theory, Hicks explicitly analyses the use of money. For instance, in the three lectures on "The Two Triads" as of 1967, he explores the possibility of matching the three functions of money with three three motives for holding it, as given by Keynes. The three functions of means of payment, unit of account, and store of value, are connected with the transactions motive, the precautionary motive, and the speculative motive for holding money, though not one-to-one. In the above section on temporary equilibrium models, the period analysis by Hicks was discussed, already. The present section discusses Hicks' work on the credit economy. Here, money's function as a means of payment and a liquid store of value are emphasized. The fact that the first function of money is referred to as means of payment rather than medium of exchange may have to do with Hicks' credit-approach to money.

In "A Market Theory of Money" (1989), Hicks derives the use of money from the functioning of markets. If transactions take place on a bilateral level, people do not need money to pay each other. Then, if they agree on some unit of account, they can exchange IOU's and thereby reduce their payments to barter exchange. However, in a situation of multilateral trade, people are no longer informed about the trustworthiness of debtors and, related to that, about the quality of the debts offered for exchange. Now that the market for bills of exchange has become less clear, there is room for intermediaries who exchange bills against other bills or against cash money. The typical transaction can be split up in three parts: the agreement on a contract, and the delivery by the two parties, one of them being in money and the other being in kind (Hicks, 1989, p.42).

The assumptions made in the market theory by Hicks differ from those of the Arrow-Debreu model in two respects. Firstly, there is no certainty, but risk or even uncertainty in the sense of Knight. Hicks himself did not explicitly choose between the two concepts of uncertainty, but focused on the

incompatibility of the general equilibrium model and money, instead. This explains why Hicks uses both risk and uncertainty. Secondly, there are transaction costs. Both assumptions have considerable impact on the outcome of the analysis.

In order to explain the existence of money, Hicks assumes the existence of risk or uncertainty. By diversifying their portfolios, people can reduce the risk they bear to a considerable extent and sometimes even to zero. This implies that a state of general equilibrium can be reached even in a situation of risk, so that money is still redundant. The result is different in an uncertain situation. The impact of uncertainty on the use of money is familiar by now: money as a store of value enables people to postpone decisions while keeping their purchasing power intact. In Hicks (1974) a description is given of sequential choices under uncertainty. Here, agents make a decision for a period of time until a new decision moment has come, in which they are free to make any decision that is compatible with their decisions made earlier and with the situation that exists at the moment of deciding. Besides risk or uncertainty, Hicks also assumes transaction costs, which cannot be reduced by diversification. Because of this, transaction costs also make the use of money an outcome of the model.

When looking at Hicks' theory of money from the point of view of the three functions of money, it can be inferred that it deals both with the role of money as a store of value and with the role of money as a medium of exchange. Money functions as a store of value in a situation of uncertainty which cannot be hedged against. In this respect Hicks' view corresponds to that of the Post-Keynesians and the buffer stock approach to be discussed below. In the market theory, money is used as a medium of exchange, and even as a means of payment. Again, the use of money comes from the existence of uncertainty which makes multilateral trading by the exchange of debts impossible.

2.4.2 Buffer Stocks

In buffer stock theory, risk and uncertainty coexist as well. Unexpected shocks,

for instance monetary shocks, can take place in an economy. In the theory of buffer stocks, which has been formulated as such by Laidler (1984), agents have three alternative ways of coping with shocks. The first alternative is adjusting their prices. If price-adjustments can be made instantaneously and at zero costs, as is assumed in general equilibrium theory, agents will chose this option. They will quickly adjust their prices until equilibrium is restored. In buffer-stock theory however, price-adjustments are not assumed to be costless, which makes individuals search for other strategies rather than adjusting their prices. Their second alternative is buying information. Information costs are assumed, which induce agents to optimize their purchases of information so that the marginal costs of an additional piece of information equal its marginal value. Here, agents face an infinite regress problem, because information is needed in order to decide upon which information to buy. The net benefits of extra information are only fully known after the information itself is there. If agents possess more information, they are better able to forecast shocks and to react to them at lower costs. The third alternative open to agents is hoarding money from precautionary motives. Holding a buffer stock of money enables agents to absorb unforeseen shocks without having to adjust their prices or buying additional information. The price of holding a buffer stock of money is equal to the opportunity costs of either the interest foregone by not buying other assets, or the subjective rate of time preference (*cf.* Laidler, 1985). Agents are assumed to be rational, which implies that they will calculate the costs of each alternative strategy and choose one, or a combination, of them such that the marginal costs equal the agents' marginal benefits.[12]

Laidler mentions a possible relation between the rate of price-flexibility

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[12] With respect to transaction costs and uncertainty, Goodhart draws a parallel with the theory of the firm by Coase (Goodhart, 1989, p.28). In choosing the optimal size of a firm, one must choose between the market, with transaction costs, and the contracting costs of internalizing transactions within a firm. The same holds for the optimal use of money, because using it on a market implies transaction costs, while internalizing transactions incurs the opportunity costs of a loss of freedom. Goodhart thus sees an optimal position between the extremes of direction in the interest of a group, such as can be seen in for instance families or monasteries, and the price mechanism that is in the interest of the freedom-loving individual.

and the use of buffer stocks. If prices are highly flexible, there is no need for hoarding money as shocks can be absorbed by the adjustment of prices. Therefore, some amount of price-stickiness is a necessary condition for buffer stocks to exist. But the causality can also be inverted. Once people hold buffer stocks, they are less inclined to change prices in reaction to a shock, as they have an alternative way of coping with it. This indicates a two-sided relationship between buffer stocks and price-stickiness.

In buffer stock theory, the money market comes into equilibrium not by the adjustment of the interest rate but by the adjustment of the demand for money. In this theory the demand for money is partly explained by the demand for buffer stocks of it, which rises from precautionary motives. Particularly in case of positive money supply shocks, agents tend to hold a larger stock of money than predicted by the values of the arguments in their demand for money function (Goodhart, 1989, p.76). If these buffer stocks are kept for longer periods of time, the interest rate does not fluctuate as much as it would do otherwise.

The buffer stock theory is a microeconomic explanation for the use of money. It has strong links with the inventory theoretic approach by Miller and Orr, although adjustments occur not equally instantaneously (Goodhart, 1989, p.79). In equilibrium, the demand for buffer stocks is related to probability distributions of shocks, so that the size buffer stocks is larger as compared to an economy without shocks. In addition to this equilibrium level of buffer stocks, some *de facto* stocks of money may be kept which result from trade proceeds. A drawback of the buffer stock theory is its lack of clear links between individual behaviour and the economy as a whole (*ibid.*, p.78). This makes the derivation of macroeconomic variables, such as the aggregate demand for money, a difficult task. Further, it is difficult to explain price stickiness from the theory of buffer stocks in a more exact way than as in the line or reasoning described above.[13] Still, the argument that both price stickiness and buffer

[13] An attempt has been made by Kuipers, who modelled the choice between buffer stocks of money versus quantity adjustments, such as consumption, investment and credit (Kuipers, 1991).

stocks follow from uncertainty contributes to understanding the monetary economy.

2.4.3 Post Keynesian and Austrian Theories

In Post Keynesian theory as well as in Austrian theory the use of money is explicitly linked to uncertainty as well as to time. The argument is built upon a distinction between two different concepts of time, which is set out clearly in O'Driscoll and Rizzo (1985). The first one is called Newtonian, logical, or operational time. It is most often used in models which are based on certainty or on risk that can be reduced to certainty. Logical time is spatialized, which means that passing through time is considered equal to going back and forth in the time-dimension. It can be seen as a flow that is independent of the things which may happen at moments of time. The independency does not hold for historical, subjective, or real time, which is the time experienced in daily life. Here, time exists because changes happen, that is, time is deduced from actions, processes and the accumulation of knowledge. The idea that subjective impression is central to the analysis implies that time can only exist if one experiences processes which take time. In a world with historical time, because of uncertainty, the information available to economic agents is different at every moment. If plans were made in historical time, the realization of them may be different from the expected outcome because in the meantime new information has become available to the decision-maker which influences his perception. In both Post Keynesian theory and Austrian theory time is historical. Investigating the role of money in a context of uncertainty and historical time contributes significantly to explaining its use.

A Post Keynesian author who clearly describes this context is Davidson. He calls an economy a decentralized monetary economy if it exhibits two characteristics:

> "(1) the existence of uncertainty in the Knight-Keynes sense so that decision-makers recognise that the future is unpredictable, and therefore, expectations can be, and often are, disappointed, and (2) the

> existence of irreversible time and the fact that production takes time and therefore it requires that commitments be undertaken by the decision-maker before the outcome can be predicted." (Davidson, 1978, p.360)

In a decentralized monetary economy money can serve to bridge the gap across time and to cope with uncertainty in the following manner. Money is a means to store value and, by this, to transfer purchasing power over time. By holding money, agents can postpone their decisions on what to buy until new information has become available to them. The flexibility increasing behaviour makes agents less vulnerable for the impact of uncertainty, that is, they are less likely to make decisions they will regret in the future, when more information has become available to them. However, this argument has two flaws. Firstly, in historical time, the future will never become known. It moves forward while one awaits it. Secondly, although an individual agent is better off by holding some amount of money instead of spending it, the economy as a whole suffers from this behaviour, because for other agents the demand and supply functions of the agent are less clearly visible than they would have been in case the agent did not hoard money. The risk-averting agent, when deciding to hoard money, most likely does not take this externality into account. The externality becomes increasingly important, the more agents behave this way. Because of this, the outcome of the economic process is less determinate in a monetary economy than in a nonmonetary economy. Moreover, all agents can never hoard more money at the same time (*cet. par.*), so the argument is subject to a fallacy of composition. Another problem that rises from the agent's procrastination is the possible incompatibility of postponing purchases with the need for goods. For example, in a very uncertain situation such as a war, people cannot wait to buy food until they are better informed about the outcome of the war. Instead, they tend to buy more food than they would have done otherwise. However, they may postpone their purchases of durable consumption goods such as furniture. This implies that people may or may not behave as Post Keynesian theory describes, depending on the type of buying decisions involved. The question now rises as to why people in an uncertain situation hoard money. The reason

as to why money is the asset most often used for transferring purchasing power, even though its rate of return may be relatively low, is found in its high degree of liquidity. As Keynes argued, the high degree of liquidity gives money a high 'own rate of interest' (1936, Ch.17). Money is an even more attractive asset for storing value if it also functions as a medium of exchange, because it is easier, and therefore cheaper, to exchange the store of value directly into a good to be purchased than to exchange the store of value into a medium of exchange first and buy a good afterwards. The combination of these two functions in one asset lowers information and transaction costs. If the value of money as a medium of exchange is fairly stable, money can also be used as a unit of account (Hoogduin, 1991, p.213; *cf.* Niehans, 1978, p.122). It is then efficient for traders to state the price of the goods they want to trade in terms of money, because this is the item for which they intend to exchange them in order to be able to buy other goods (Laidler, 1990, p.51). One can even argue that the advantages of a medium of account[14] can only be realized if the unit of account is also used as a medium of exchange (Niehans, 1978, p.121). This argument rests on the assumption of information and transaction costs, which are lower if the two functions are performed by one asset.

The Post Keynesian approach to money described above differs from the approach taken by Austrians. The difference has partly to do with differing views on the stability of a monetary economy. Austrians as well as Post Keynesians assume that individual agents live in an uncertain world. But, whereas Post Keynesian authors see an economy as possibly unstable, Austrians consider it stable in the sense of being able to absorb shocks. Instead of looking at the economy as a whole, Austrian authors focus on the individual agent and on his thinking that leads up to his choices. From that subjectivistic point of view, the Austrians seek to explain how agents in an economy coordinate their decisions so that the economy moves towards a stable outcome.

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[14] For the distinction between a medium of account and a unit of account made by Niehans (1978), the reader is referred to the part of section 2.2.2 on the unit of account.

They attach importance to the contribution of money to coordination, but adhere to methodological individualism. The coordinating function of money serves as an explanation for the 'Invisible Hand', a notion often used in (neo)classical theory, as will be described now.

Already in 1892, Menger took an evolutionary approach in his description of the advantages of using money above bartering in his article 'On the Origin of Money'. According to his view, a satisfactory theory of money had not been found. By implication, he disqualified the already existing theories based on general conventions or legal dispensation as such. Because of Menger's demand side orientation, the Classical notion that the value of money is derived from its production costs is not even mentioned. Menger observed a conflict in underpinning the outcomes for the economy as a whole from the interest of individuals. It is only attractive for individuals to use money if other individuals use it as well. This conflict is typical of coordination problems in general. In practice, money helps to solve the coordination problem. However, the analytical problem regarding the selection of money remains, because of the externalities involved in its saleability. Menger analyses the saleability aspect of goods and argues that some goods are more saleable than others because of certain characteristics. He then states:

> "Men have been led, with increasing knowledge of their individual interests, each by his own interests, without convention, without compulsion, nay, even without regard to the common interest, to exchange goods destined for exchange (their "wares") for other goods equally destined for exchange, but more saleable." (Menger, 1982, p.76).

These more saleable goods tend to become even more saleable the more they are used. According to Menger, this self-enforcing process leads to a dichotomy between money, for instance coins, and other commodities. Iwai shows that this is not the case, because the non-monetary transaction model is stable, so that a process of monetization does not evolve endogenously. A shock is needed in order for a dichotomy to occur, so that the evolution towards a monetary exchange takes place (Iwai, 1996). Although the transaction cost approach taken

by Brunner and Meltzer resembles Menger's line of reasoning, the emphasis is different. Menger explicitly derives his explanation of the use of money by individual motives, whereas in the transaction cost approach the economy as a whole is central to the analysis. In the works of other Austrians, money is seen as a commonly accepted medium of exchange: "A money is whatever good an individual agent can reasonably expect will be commonly accepted in indirect exchange" (Wärneryd, 1989, p.615). The quotations from Menger and Wärneryd give an indication of the difference between Menger and later Austrians with regard to their view on money as a convention. Menger explicitly excludes the possibility of money being a convention, whereas neo- Austrian authors support the idea. In this subjectivistic definition of money no attention is paid to characteristics of the good that is used as money. Money is seen as the self-enforcing outcome of a coordination game. In such a coordination game, low cost characteristics of the commodity used as money are a necessary, but not a sufficient condition for the selection of one medium of exchange. A description of this coordination process has been given in Hayek (1949). He states that an economy tends to an equilibrium if the knowledge and the intentions of individuals increasingly agree with each other. By the learning of individuals, their subjective data become more congruous with each other and with the objective data. This implies that the learning process of individuals forms the basic mechanism for the coordination in an economy and the realisation of a stable outcome. Hayek (1976) even goes as far as to plead for competition in the supply of currencies as a substitute for government-regulated supply, or other forms of centralized money supply such as by a central bank. According to this 'free banking theory', competition in the supply of money decreases the level of inflation and improves the stability of an economy. This implies that Hayek puts more trust in the learning process of individuals than in the performance of a government with respect to coordination and economic stability. Still, an *ex post* rationalization of the persistence of the conventional use of money does not suffice for an evolutionary account of its emergence. In that sense, the analysis by Menger is not satisfactory. One could even argue that the commodity money is by definition the most saleable good, as it is accepted at

all markets. The same can be said about Keynes' treatment of money, which views it as the most liquid asset without explaining how money comes into existence in an economy. Instead, Keynes discusses the specific properties of an asset used as money (1936, ch.17). Analyses which explicitly take the conventional aspect of money into account, like those by Hayek, are more promising with respect to rationalizing the use of money. The question as to how money came into existence is not the subject of study here. As Iwai puts it: "Such a question is certainly better put into the hands of historians, archaeologists and numismatists" (1996, p.474).

Post Keynesian Theory can now be compared with Austrian Theory with respect to the explanations and the functions of money. Both theories derive the existence of money from uncertainty. They differ in their assumptions of the reactions of agents to uncertainty. In Post Keynesian Theory the agents react quite passively to uncertainty, namely by hoarding money and, by doing so, postponing their buying decisions until more information has become available to them. From this behaviour it follows that the function of money as a store of value is emphasized. In Austrian Theory, individuals show a more active behaviour. By using money to trade on markets, agents give as well as acquire information about the actual demand and supply conditions. In its function of a medium of exchange, money then becomes an information carrier and improves the coordination of individual actions in an economy. Here, the function of money as a store of value plays a minor role as compared to money's role as a medium of exchange.

2.5 Taking Stock: Theories of Money

This chapter started with the Arrow-Debreu model in which an auctioneer takes care of the coordination and of the allocation in an economy. This model was characterized by its static character, the assumption of perfect information, and the absence of information and transaction costs. Money was shown to be redundant because of these characteristics. This is to be expected of models

which treat money as an n-th good in a Walrasian economy. Then, the difference between money and other goods is one in degree rather than in kind, because money's value is only determined by its saleability by which it increases the efficiency of the economy (Niehans, 1978, p.2). However, money is not traded at an *n*-th market of its own. The fact that it is a medium of exchange at all markets, and the neglect of factors which make money valuable, such as price setting behaviour, make the Arrow-Debreu model inadequate for analysing money (Niehans, 1978, p.7; Iwai, 1996, p.475). Therefore, additional assumptions were needed to explain the existence and use of money. To some extent, these additional assumptions can be considered as frictions in the standard model, which allow for a role of money in curing the effects of these frictions. The introduction of operational time and of information and transaction costs helped to explain the use of a money, but was not enough for determining what asset should function as such. This conclusion was derived after a discussion of overlapping generations models, temporary equilibrium models and search equilibrium models, in which one or more of these assumptions were made. Subsequently, theories were analysed which do not analyse frictions, but take a fundamentally different starting point in allowing for uncertainty or risk. In the market theory of money by Hicks, the liquidity of money also plays a role as does the structure of the money market in which intermediaries operate. The buffer stock approach emphasizes the demand for money that is derived from this precautionary motive. Money is chosen for transferring purchasing power because of its high liquidity, which in turn stems from its general acceptance. From these models it followed that money is not only used for facilitating trade, but for increasing flexibility by postponing buying decisions as well. Both Keynes and Menger have described this characteristic of money, although Menger calls it saleability. In the Post Keynesian model and the Austrian model, historical time as well as uncertainty in the sense of Knight plays a role.

Introducing uncertainty while leaving out the auctioneer has a drastic impact on the economy under study. The auctioneer no longer takes care of the process of allocation, so that agents have to find equilibrium prices themselves.

Moreover, he is no longer there to secure the coordination of decisions whose outcomes are interdependent, as for instance pricing and exchange decisions. The advantages of using money for calculating and communicating these prices were discussed. An illustration of the interaction of money and nominal prices has been given in the discussion on the theory of buffer stocks, where a relation between buffer stocks and nominal price-flexibility was suggested. Money also contributes to the process of coordination once there is no auctioneer to take care of this. The fact that the medium of exchange is a convention makes it highly liquid, whereas its liquidity makes it an attractive medium of exchange. Analytically, the circle has to be broken by a shock, because in search theoretic exchange models like Iwai's, all goods are similar at the start (Iwai, 1996). Moreover, even if such a shock brings an economy to switch from direct to indirect exchange, it also has to indicate which good is to be used as money. Fortunately, history suggests otherwise (*cf.* Redish, 1993). While arbitrary from the modellers' point of view, the real world has asymmetries which make agents focus on coordination outcomes, so that money can evolve. Therefore, the models can be useful in analysing the coordination problem involved in using money, but they must be combined with studies of monetary economies in practice in order to provide a complete analysis of the impact money has on the exchange process.

The more attention is paid to uncertainty, the more difficult it becomes for individuals to coordinate their actions, as they lack information about other people's plans and actions. The combination of the three functions of money makes it a coordinating instrument. Firstly, as a medium of exchange, money carries information about demand and supply conditions. Secondly, money as a unit of account makes trade easier as all prices can be stated in terms of money. Finally, money as a store of value enables people to postpone their market transactions until more information has become available to them. The combination of three functions in one asset explains why money is suitable for coordinating the actions of individual agents in an economy in the absence of the Walrasian auctioneer. It also explains why theories that are based on the assumption of uncertainty and historical time are able to provide an

explanation of the existence and the use of money. Theories that miss this assumption can only explain partial money, but those theories cannot be combined in order to derive an explanation of money in its three functions. They have difficulties explaining why money is used as a store of value even when its yield is lower than that of other assets, unless they already assume that money is the good with the lowest transaction costs. Still, a drawback of the theories in which uncertainty is assumed is the difficulty one experiences when trying to derive conclusive results from them. In other words: "the more uncertainty, the less one knows" does not only hold for the agents in the economic model, but for the economic theorist as well.

3 Theories of Nominal Price Stickiness

3.1 Introduction

Nominal price *rigidity* occurs whenever prices in terms of money do not change. Nominal prices are said to be *sticky* if they do not fully accommodate a change in the monetary aggregate. By implication, a monetary shock has real consequences: money matters. This is not to say that agents must be subject to money illusion as defined in chapter 2. It may equally well imply that nominal prices perform other functions besides reflecting supply and demand conditions. The impact of the fact that prices are expressed in terms of the monetary unit on the stickiness of prices is the topic of the present chapter. The distinction between nominal and real prices, or nominal and real wages, is only relevant in situations of incomplete information or uncertainty, because in these situations economic subjects lack the information they need to calculate nominal variables into real ones (Bliss, 1992, p.23). They are also uncertain with respect to the actions taken by other agents. Most theories start from incomplete information rather than fundamental uncertainty in order to derive the result of nominal price rigidity. These theories are unable to deal explicitly with the possible contribution of nominal prices to solving coordination problems involved in price setting decisions under uncertainty, so that they result in partial explanations of nominal price rigidities. Still, starting from incomplete information can be a useful strategy for identifying the exact causes of nominal price rigidity.

The phenomenon of price rigidity is often studied because of the implicit assumption that prices clear markets. If this assumption holds, then price rigidity bothers economists because it implies that markets are not cleared. However, in markets which clear by adjustment of other variables than prices, price rigidity may be less bothersome (Carlton, 1989, pp.921, 939). When price rigidities are identified, it is therefore important to determine whether or

not they result in market clearing. Further, if prices are indexed, they may be rigid because the indexing clause is not invoked. Therefore, the study of prices should be distinguished from the study of pricing. Prices refer to numerical values, while pricing refers to "the behaviour and judgements that determine prices" (Tool, 1995, p.47). Prices result from pricing, and sometimes from price negotiations, but explaining pricing calls for a search for underlying factors. For establishing a link between the use of money and nominal price rigidity, a study of pricing is necessary. If theories are able to explain observed nominal price rigidity, they can contribute to understand the rationale behind them. However, in case theory fails to explain them, either with or without assuming rationality in pricing, the possible use of price rigidities for market participants cannot be derived.

Economists who tried to explain nominal price rigidity have come up with several theories. A theory which is closely related to neoclassical economics is the New Keynesian theory of price stickiness, which consists of two parts. Firstly, price stickiness is explained from individually rational behaviour. Theoretical notions like menu costs, price rules and staggering can be used for arguing that not adjusting prices can be the optimal response to shocks as long as the marginal costs of adjusting prices are larger than the gains from doing so. The argument implies that the decision whether or not to adjust prices can be made subject to a threshold criterion, that is, prices are adjusted if their deviation from the optimal price is larger than the threshold. In that case, the adjustment will be relatively large, because adjustments smaller than the threshold will not be made. However, most of these theories, which strictly follow methodological individualism, are incomplete, because their focus on prices neglects the impact of coordination problems on pricing. In some sense, they can be considered micro oriented rather than macroeconomic in character. The model of price stickiness and coordination failures developed by Ball and Romer (1987) is one of the exceptions which will be discussed in section 3.2.2. Secondly, the New Keynesian theory of coordination failures underpins the interdependency of pricing strategies, thereby showing that price stickiness not

only results from individual pricing behaviour, but from collective outcomes as well. An economy or a market may get stuck in some inferior pricing scheme without providing the incentives to step out of it. This second strand of New Keynesian theorizing is complementary to the first one. However, it only identifies a problem without indicating how the particular coordination problem involved in pricing is, or can be, solved in a monetary economy.

Theories which take an entrepreneurial behaviour approach to pricing, instead of devaluing it to the algorithm of optimizing behaviour, allow for other reasons prices setters may have for keeping their nominal prices unchanged for some period of time. In the theories of cost-based pricing, mark-up prices and administered prices, the situation at the market is taken into account by a price setter. The emphasis on the optimal reaction of the individual price setter to his market environment gives these theories a microeconomic emphasis, as opposed to the theories on coordination failures mentioned in the former paragraph, which focus on the interdependence of pricing decisions and can therefore be characterized as macro-oriented. Administered prices are prices that are "set by someone, usually a producer or seller, and kept constant for a period of time and for a series of transactions" (Stigler, 1968, p.238). They can be seen as opposites of market prices, which "fluctuate on the basis of supply and demand" (*ibid.*). In this terminology, markets with perfect competition will clear by market prices, thanks to the metaphorical auctioneer. By implication, pricing theories in which suppliers are able to post prices only hold in markets with imperfect competition, such as oligopoly markets and markets with monopolistic competition.

Other theories suggest that prices may serve as an instrument for signalling intentions concerning the trading relationship, like Okun (1981) describes in his price-tag economy with customer markets, or prices may communicate other information. In the last section, the use of conventions and institutions as a way of coping with coordination problems in pricing is hypothesized. This idea serves as a link with the preceding chapter on the theory of money as well as the next chapter on coordination problems.

3.2 New Keynesian theories

The New Keynesian theory of nominal price stickiness resembles neoclassical theory in that it assumes rational, optimizing behaviour. The Keynesian aspects are found in the assumed stickiness of nominal wages and systematic changes in aggregate demand, which may influence the level of aggregate production and employment. The combination of these two characteristics make New Keynesian economics an approach which tries to derive 'Keynesian results' from individually optimizing behaviour. An example can be found in the treatment of nominal price rigidities in Blanchard and Fischer's work (1989, chapter 8). The authors start by giving a historical overview of what they call Keynesian economics, describing this as economics which attempts to explain co-movements of real wages, employment and output at the one hand, and the effects of aggregate demand changes on employment and output on the other hand (*op. cit.*, p.372). The approach is said to have started from the assumption of rigid prices and wages. In the 1970's, "disequilibrium" or "fixed price equilibrium" macroeconomics studied the macroeconomic equilibrium that resulted from the interaction of a given price and wage vector and specific rationing rules. The main result of these exercises was that the difference of a price vector from the equilibrium price vector determined the way an economy would react to a given shock (*ibid.*, p.372). Remarkably, Keynesian economics is described as starting from rigid nominal wages and prices. However, it seems that this is the outcome rather than the starting point of Keynes' argument. Keynes gives reasons why prices and wages may be rigid, but his explanation of unemployment does not hinge upon it (Keynes, 1936, p.27; Davidson, 1994, Ch.17).

Taking individual optimizing behaviour as a starting point of analysis has two drawbacks. First, it is methodologically individualistic and thereby cannot deal with interdependencies. Actions of others cannot be taken as given, so that the result for the whole becomes indeterminate. For instance, if all other agents are 'not rational', it may be 'rational' to follow suit. New Keynesian

models do not allow for such form of procedural rationality.[1] Second, the time horizon of individuals is not taken into account. For instance, if building a reputation of credibility is profitable in the long run, in the context of a static optimization model, such behaviour is considered irrational because short-run profit opportunities may be left unexploited.

Trying to derive Keynesian results like involuntary unemployment or wage and price rigidities from individually rational behaviour forces New Keynesians to take either of two approaches (Akerlof and Yellen, 1987). The one option is to amend the assumptions concerning the context in which the individual agent operates. Thus, markets are assumed to be imperfect, transaction costs are assumed, information is asymmetrically distributed, limited or costly, or other rather *ad hoc* assumptions are invoked. The other option amends the characteristics of the individual agent by relaxing the rationality assumption. This allows for rule-of-thumb pricing, considerations of equity and fairness, and money illusion. Both approaches can serve the purpose of deriving Keynesian outcomes. Often, the first one is preferred because it preserves the notion of a rational individual agent. The theory of near rationality is a hybrid of the two, because the individuals are rational in that they pursue the highest net benefits, that is, they compare the costs and benefits of price adjustment, while their behaviour is said to be irrational because a short-term profit opportunity is left unused. Both this theory and theories which start from impediments to perfect competition are discussed in this section.

The above assumption of imperfect competition allows for studying price setting behaviour, which is ruled out in perfect competition settings. In terms of the distinction by Tool mentioned above, perfect competition only allows for a study of prices, whereas assuming imperfect competition allows for a study of pricing. In general, the New Keynesian explanation of market price

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[1] Several concepts of rationality are discussed in chapter 4. Procedural rationality refers to a rule of action which is profitable, even though individual actions may not always be so. Instrumental rationality referes to optimizing behaviour at every instance of action.

rigidities is sought in the supply side of the economy, whereas the demand side is modelled along the line of a 'quantity theory of money' equation (Van Ees and Garretsen, 1993, pp.324, 343). To sum up, in this section the focus will be on price setting behaviour by rational, incompletely informed suppliers in markets that are characterized by imperfect competition.

The following discussion draws mainly on Akerlof and Yellen (1987), Rotemberg (1987) and Blanchard and Fischer (1989). These New Keynesian theories of nominal price rigidity all start from microeconomic behaviour and as such follow a methodological individualistic approach. First, the notion of menu costs is introduced, together with the theory of near rationality. Then, state dependent price changes are discussed, which cause monetary shocks to have real effects. This need not be the case with time dependent price rules and staggering prices. These theories all start from individual rational behaviour, thus neglecting coordination issues involved. The other part of this section deals with coordination problems which may cause nominal price rigidity. Though this theory does not deal specifically with price setting behaviour, it contributes to clarifying the motives agents may have for not adjusting prices, other than cost-benefit analyses.

3.2.1 Micro: near rationality and menu costs

An economy in which money is neutral suffices the following description:

> "If there is no money illusion and if outstanding debts are revalued (or, alternatively, if there is a neutral distribution effect), then a uniformly introduced increase in the amount of money causes a proportionate increase in the equilibrium prices of commodities and leaves the equilibrium rate of interest unaffected." (Patinkin, 1956, p.59)

The assumption of imperfect competition is compatible with neutral money, because rational producers will take real money into account when setting their prices, that is, imperfect competition does not imply money illusion. In case changing prices is costly, however, prices may not fully accommodate a shift in the monetary aggregate, so that nominal money has real effects. In the New

Keynesian models, the monetary aggregate influences production and consumption behaviour via its influence on real money balances. Then, monetary shocks are not fully transmitted via nominal price adjustments and money is no longer neutral.

The theory of **near rationality** sets out why this is so, even if individual price setters strive to optimize. The theory assumes positive costs of changing prices, which can consist of calculating new prices and communicating them. Given the existence of such costs, even rational suppliers may find it optimal to refrain from adjusting prices. This feature is called near-rational behaviour, because rationality implies money neutrality, whereas with menu costs "agents have relatively wide latitude for deviating from full optimization without incurring significant losses" (Akerlof and Yellen, 1987, p.138). Note that the interpretation of the term rationality hinges on the assumption of zero transaction costs. The situation can be explained from the envelope theorem, which states that "the impact of an exogenous shock [of the state variable] on a fully maximizing agent is identical, up to a first-order of approximation, whether he optimally changes his decision variable in response to a shock, or instead responds inertially" (*ibid.*, p.139). This implies that, after a monetary shock, not adjusting prices only incurs a second-order private loss, but has a first-order effect on collective welfare (*ibid.*, p.139). The individual price-setter only compares his second-order private loss to his costs of price adjustment and acts accordingly, thus incurring an externality on the economy. The result for the economy is that monetary shocks may not be accommodated by price changes, so that quantity adjustments are made, which have a first-order impact on welfare. As a result, "inertial price setting is almost costless, even though its macroeconomic impact is significant" (Akerlof and Yellen, 1987, p.139). An issue that remains implicit is the reference to equilibrium, which may be useful as a starting point but ceases to exist once price inertia has occurred. Although price setters behave (nearly) rational, the economy is out of equilibrium. Prices do not reflect scarcities, so that agents have difficulty calculating their equilibrium prices on the basis of external data, like prices of others. To sum up, if all agents show near rational behaviour, the equilibrium

benchmark no longer exists, so that the microeconomic argument for near rational price setting behaviour differs from its macroeconomic implication.

In general, the costs of changing prices are referred to as **menu costs**. In a literal interpretation, these costs can be thought of as the costs of issuing new price catalogues, printing new price labels, or, in a restaurant, the costs of printing new menus. Figuratively, they also refer to the costs of calculating and communicating new prices. Usually, menu costs are assumed to be fixed as well as symmetrical, the latter meaning that adjustment to either side is equally costly. The theory of menu costs contends that price changes will only be made if the gains to be won by doing so exceed the menu costs to be made. A related theory, the so-called *Ss*-pricing rule, views these menu costs as a band around the present price with a width that is as large as twice the menu costs (*e.g.* Blanchard and Fischer, 1989, §8.3). If circumstances change in such way that the optimal price is further away from the present price than the width of the band, then the price is adjusted. This results in staggering prices as they are adjusted discontinuously with relatively large adjustments. Still, suppliers will be reluctant to lower prices if they consider the price elasticity of demand to be low and reluctant to increase prices if they consider the price elasticity to be high. Moreover, even if the costs of not doing so have become large, suppliers may hesitate to change their prices because they may fear that their price adjustments will be interpreted as a signal of changing market conditions (Carlton, 1989, p.931). The point by Carlton can be seen as an application of the remark by Bliss quoted above, stating that in situations without complete information, nominal and real price setting may be different or perceived differently.

Menu costs cause a coordination problem, which runs two ways. In one way, whether or not it is optimal to adjust prices not only depends on the magnitude of the adjustment costs, but on the choice other suppliers make as well. The same holds the other way around: if a supplier adjusts his price, it becomes more efficient for others to do so as well, so that an externality exists. This externality involved in adjusting prices leads to multiple equilibria, with

or without the possibility of Pareto ranking the equilibria. If this ranking is not possible, the choice of an equilibrium becomes a pure coordination problem, which is not solved by the model. In accordance with Blanchard and Fischer (*op. cit.*, p.384-386), this issue can be formalized as follows:

Let k be the fraction of sellers who adjust their prices, so that k serves as a rough measure of the change in the price level. The costs of not changing prices after a given demand shock (dM/M) can be captured in a loss function, which partly depends on k:

$$L = L(k) \qquad 0 \leq k \leq 1$$
$$L'(k) > 0$$

Suppliers compare these costs with the fixed menu costs of changing prices c in order to decide on whether or not to adjust their prices. Therefore, their decision rule is:

If $L(k) > c$ then adjust price;
if $L(k) \leq c$ then do not adjust price.

This decision rule, if followed by all suppliers, results in multiple equilibria. If c is larger than $L(0)$ or smaller than $L(1)$, prices will never or always be adjusted, respectively. If $L(k) > c$, then all suppliers will adjust their prices, so that $k = 1$. Accordingly, if $L(k) < c$, then no one will adjust prices, so that $k = 0$. These two equilibria are stable. If the fraction of suppliers who adjust their prices k is such that $L(k) = c$, then an unstable equilibrium exists. Any small deviation of $L(k)$ from c will cause k to change in such way that one of the stable equilibria results. Ergo: the optimal actions of the suppliers are interdependent.

Although the theory of menu costs can only describe the coordination problem faced by monopolistic or oligopolistic price setters in models such as repeated above, it satisfies the criterion of explaining nominal price rigidities from individual optimizing behaviour, which makes it a useful tool of analysis. However, it does not explain why it is prices that remain sticky instead of quantities. As Greenwald and Stiglitz put it:

> "However, since the fixed costs of quantity adjustments (layoffs, etc.) are widely regarded as being greater than the costs of price adjustment, this basic approach argues as (or more) strongly for quantity rigidities than for price rigidities." (Greenwald and Stiglitz, 1989, p.364)

One of the reasons as to why quantity adjustments are costly is the occurrence of spillovers. Due to the externality thus caused, the individual costs are smaller than the social costs, *e.g.* unemployment benefits. However, the costs of price adjustments can also be substantial. In defence of the menu costs explanation it can be mentioned that the costs of changing prices may be larger than the costs of changing quantities. The rationale behind this argument is that changes in prices have to be communicated to all of a firm's potential customers, whereas a quantity change only has to be communicated within the firm. This argument was raised by S. Fischer in a discussion of a paper by Rotemberg (Rotemberg, 1987, p.115). Price changes may also be more expensive than changes in quantity because price changes are more likely to cause strategic reactions by competitors, whereas quantity adjustments preserve the status quo at the market. However, one can doubt the realism of the argument that changing quantities is cheaper than changing prices. Obviously, the costs of quantity rationing and thereby losing customers are neglected here. They may as well be larger than the costs of raising prices, although losing customers may also result from raising prices. Greenwald and Stiglitz (1989) also stress that the idea of not adjusting, or maintaining the *status quo*, is ambiguous, because many variables can be kept fixed, in absolute as well as in relative terms. So, even if it may be considered rational not to always adjust prices, the quantity adjustment that results does not seem *a priori* equally rational. Therefore, this theory does not deal with price rigidities in particular.

In spite of the above drawback and the limited possibility for using menu costs in a dynamic context, the notion can be used for interpreting actual data on price movements. It can be hypothesized that if menu costs are substantial, then relatively large price adjustments will be observed. Both Carlton and Kashyap found evidence of small price changes. In line with the hypothesis, Carlton (1989, p.932) suggests that menu costs may be small, though he doubts whether this conjecture is realistic. Carlton also suggests that large menu costs can be reconciled with small price changes in case price setters expect the changed demand and supply conditions to hold for a long time

(1989, p.932, fn.19). However, his argument goes together with a caveat. By inferring the size of menu costs from the size of price changes, one runs the risk of reversing the causality and thereby arriving at a tautological statement: "If menu costs are of size x, then most price changes are expected to be larger than size x, while if price changes of size y are observed, then it will be concluded that menu costs are smaller than size y." Kashyap (1995, p.265) discusses a model in which menu costs were set random. In that case, the probability of firms to change their price is randomly, as is the size of the price changes. This experiment supports the relevance of the issue of causality in empirical studies on menu costs.

Kashyap's own empirical study is based on retail catalogue data. He observes that both the size and the frequency of price changes differ to a large extent. These observations cannot be explained by assuming constant and fixed costs of changing prices. An assumption of time variant menu costs is not rejected by the data, but difficult to underpin and therefore less credible (Kashyap, 1995, p.269). Lach and Tsiddon (1994) studied price data of food products that were acquired on the level of individual multi-product stores. The price changes they found were fairly infrequent. Their finding called for further research in order to find the pattern behind the price changes. In general, examining the pattern of price changes is necessary for interpreting price data. For instance, in a multi product case, if all suppliers change the prices of a fraction of their products simultaneously, this can result in the same data on the frequency of price changes as results from the situation in which the same fraction of the suppliers changes all their prices. The impact of both patterns on sales may be entirely different, depending on substitution effects within or across stores. Therefore, data on the frequency of price changes often call for further study in order to find out what pattern of price changes creates them (Lach and Tsiddon, 1994, p.2). In their study, Lach and Tsiddon distinguished between the standard model in which price adjustments of the same products are synchronized across stores and a model with across-store staggering and within-store synchronization. The latter model turned out to be explanatory for their price data. The authors inferred that menu costs play a role at the store

level, and concluded that if a store decides to adjust its prices, the price changes for individual products can be either large or small. Further, as the costs of printing new 'menus' are shared by all products, within-store synchronization can be explained from the menu-cost argument (Lach and Tsiddon, 1994, p.33). The model thus derived, in which the timing of price adjustments enabled the authors to develop an alternative interpretation of the notion of menu costs, may provide a more powerful explanation of the size and frequency of price changes that are observed than the standard model offers. Moreover, it may contribute to analysing price adjustments across products and sectors. However, things may not be that simple, since storekeepers will commonly not change all their prices at once in order not to drive away their customers (*ibid.*, p.3). The latter aspect of pricing behaviour may be better explained by the theories to be discussed below.

Based on the notions of near rationality and menu costs, New Keynesian theory also offers explanations of nominal price rigidity in which price rules play a role. Two types can be distinguished, in which price changes depend on the state of the economy or on time intervals.

State dependent price rules make price changes dependent on the magnitude of changes in demand. These changes are assumed to occur randomly, so that the price setter faces risk. Starting from the optimal price given a level of demand, if a demand disturbance occurs, prices are only changed if the demand shock exceeds a pre-set size. Such price setting behaviour is (near) rational, because changing prices is assumed costly. Often, state dependent price rules are called *Ss*-rules, with *S* being the upper limit on demand and *s* being the lower limit on demand which, if reached, trigger price adjustments. *Ss*-rules can be either one-sided or two-sided, the latter being called symmetric. More sophisticated types of state dependent price rules stem from the same basic idea, namely adjustment at boundary levels of a target variable (see *e.g.* Blanchard and Fischer, 1989). This variable can be relative prices, cash balances (Miller and Orr, 1966), exchange rates, or another variable.

The average magnitude of price adjustments in two-sided *Ss*-rules

depends on the behaviour of the factor that causes a demand shock, for instance the quantity of money in the economy. If there is a drift, the distribution of adjustments becomes skewed. An extreme form of drift, being disturbances only to one side, makes the *Ss*-rule one-sided and the average size of the price adjustments equal to the *Ss*-band. An example of a one-sided *Ss*-rule that relates to nominal price setting is the price setting rule a monopolistic competitor may employ in situations of inflation, which bring about a positive drift in the price level. He then keeps his nominal price constant until his real price has decreased and reached the lower limit *s*. Then the price setter increases his nominal price until his real price is *S* again. Aggregation brings about the effect of price staggering, which will be introduced below, and, perhaps surprisingly, money being neutral. So, in a one-sided *Ss*-rule model of price setting behaviour money is neutral at the level of the economy as a whole, despite costs of price adjustment at the level of the individual price-setter, which may affect the situation at the micro level. Even though "as a matter of logic, nominal stickiness requires a cost of nominal adjustment" (Ball and Mankiw, 1994, p.17), the conclusion follows that in New Keynesian models costs of price adjustment are a necessary, though insufficient condition for nominal rigidities. The result of neutrality of money does not hold for two-sided *Ss*-rules or for the time dependent price rules that follow below. It only holds for one-sided *Ss*-rules because in these situations all adjustments are of equal magnitude and direction and only those price setters who have become furthest away from their desired price do adjust (Blanchard and Fischer, 1989). Another qualification must be made with respect to the neutrality result, as this is based upon a one-good model. In case more goods are considered, so that the price level becomes an index measure, movements in the general price level not only depend on price adjustments, but also on whether or not a monetary shock affects all markets equally. Further, the incentive to adjust prices is based on relative prices hitting a boundary rather than nominal ones. State dependent pricing rules do not indicate any timing of price changes: the timing of price changes can become as random as the state indicator's behaviour. In this respect, time dependent price rules are exactly opposite: the timing of price changes is determined,

whereas the magnitude of the price changes is not.

Time dependent price rules have in common that prices are a function of time, meaning that they are changed at regular intervals of time. Two types of time dependent price rules exist. The first type holds prices fixed during the interval, whereas in the second type prices are only predetermined during the interval. In the latter case, indexation and predetermined price increases remain possible. Examples of the first type can be found in list prices of consumer durables, while more-years loan contracts are examples of the latter type. Sometimes, indexation is state dependent, such as in loan contracts that only guarantee indexation if inflation remains within some range. In the case of fixed prices, the non-neutrality of money is obvious as by definition no accommodation of monetary shocks occurs. In the case of predetermined prices, however, the neutrality of money depends on whether changes in the monetary aggregate were expected at the time of predetermining prices or were unexpected at that time. In the former case, money is neutral[2], and in the latter case it is not. In an economy with time dependent predetermined price rules, several sectors often set their new prices at different times. This leads to the phenomenon of staggering, which refers to the price level adjusting gradually to monetary shocks, because all sectors adjust at their own time (Rotemberg, 1987, p.90). The sectors that do not adjust instantaneously to a monetary shock, because their price setting contracts are not expired yet, have to adjust via quantities. This leads to inertia: it takes a fairly long time before a monetary shock is accommodated. The rather vague term 'fairly long' can be measured by a parameter called the degree of inertia (Blanchard and Fischer, 1989, p.397). Generally, its upper limit is the period of the contract with the longest duration. The time for accommodating can be reduced if price setters find it optimal to change their prices at the same moment others do. The staggering effect thus diminishes and strategic complementarity leads to bunching behaviour.

[2] If costs of price adjustment are assumed, even in this case money may not be neutral. However, this effect does not depend on whether or not monetary shocks are expected.

Bunching behaviour can be observed in wholesale markets and markets for consumer durables, where new price catalogues are often issued each January, and in retail markets where discount offers often hold from Monday to the next Saturday. The notion of bunching explains that rational price setters may find it optimal to issue their new prices at the same time, but it does not determine the very moment of doing so. Again, a coordination problem is indicated without being solved, which supports the view that a theory which starts from individual pricing behaviour cannot be complete.

Now that state dependent price rules and time dependent price rules are introduced, they can be compared. The choice for a particular type of pricing rule depends both on the costs of learning about the state and on the costs of actually changing prices. If the costs of learning about the state are high, then a time dependent price rule is most efficient, because this saves the costs of continuously monitoring the state of the economy in order to determine whether or not a price change is appropriate. Likewise, a state dependent price rule will be chosen if the costs of changing prices are high, because in this case the costs of changing prices are only incurred if they are less than the gains to be won by adjusting prices (Ball and Mankiw, 1994, p.23). However, most often both types of price rules are used in a mixed form. For instance, a mixed rule can consist of monitoring the state at regular intervals and only changing prices if the state has changed beyond pre-set boundaries. The example given above of a loan contract with limited indexation, can also serve as an illustration here.

In practice, many examples of both types of price rules and hybrid forms can be observed. In the paragraph on time dependent price rules, two everyday life examples of time dependent price rules were given already. State dependent price rules are often related to inflation. A common example is the indexation of wages and some kinds of taxes. A mixed form appears in the pricing of newspapers and journals: new prices are only set at the beginning of a year, unless paper prices rise sharply during a year. This leads to another aspect of price setting behaviour, namely the question as to what price increases are considered 'fair' by suppliers and their customers. For instance, in the

tourism branche, travel packages are offered for a fixed price during the season unless large and unforeseen cost price increases occur. This issue will be dealt with in another part of this chapter, as New Keynesian theory does not allow for such 'irrational' behaviour.

Before starting a digression on the New Keynesian theory of coordination failures, a preliminary assessment of the above New Keynesian theories of nominal price stickiness is given. To start with, its presuppositions allow for realistic modelling as compared to the assumption of perfect competition. In the real world, many markets are of a monopolistic competitive character with rational, though incompletely informed, price-setters. The degree of realism in the models of price rules and menu costs is therefore rather high. However, some explanations for nominal rigidity seem *ad hoc* with regard to why it is nominal prices that are rigid. For instance, as was discussed above, the theory of near-rationality can equally well serve as an explanation of quantity non-adjustment. The same may hold for the two types of price rules. For example, if a producer yearly updates his production plan, this could be called a time dependent quantity rule. This is not to say that prices and quantities are always symmetric. Whereas price decisions are likely to result in strategic reactions by competitors, quantity decisions are likely to feed back upon inventories, employment rates, and the demand for inputs. However, the fact that prices are set in terms of a unit of account is not relevant to the theories discussed up till now. This makes an integration of the New Keynesian theories of nominal price rigidity with the features of a monetary economy a difficult task. Empirical observation also reveals that nominal prices remain sticky even in times of changes in demand. In some markets, if times are bad, cutting the service level is more often done than lowering prices (Blinder, 1991a, p.17).

Although the theories do not deal explicitly with money, they provide an underpinning of nominal price rigidities in terms of some unit of account from individual optimizing behaviour. However, sooner or later they all lead to coordination problems, because the optimal action for individuals depends on the actions undertaken by others. The existence of coordination problems

calls for a more macro oriented complementary theory. Therefore, in the following section the New Keynesian theory on coordination failures is discussed.

3.2.2 Macro: coordination failures

The New Keynesian theory of coordination failures differs from other New Keynesian theories, because the theory not only holds for rigid prices, but for flexible prices as well. In the theory of coordination failures the Keynesian results do not follow from price rigidities but from the multiplicity of equilibria: an economy may get stuck in a low-employment equilibrium. This general concept can be applied to the study of pricing: nominal rigidities may arise from a failure to coordinate price changes. Therefore, price stickiness is not an assumption, let alone a 'Keynesian' one, but a result of the theory.

The actions taken by agents in an economy are characterized by two features: spillovers and strategic complementarities, which will be defined here as is done by Cooper and John (1988, p.488). Spillovers occur when one player's strategy affects the payoffs of the other players. Strategic complementarities exist if an increase in one player's strategy increases the optimal strategy of the other player. The term strategy refers to an effort level so that it is quantifiable, such as for instance a level of production (Ball and Romer, 1987, p.1). Strategic complementarities create interdependency between economic agents, because they take into account optimal decisions taken by others while making their own optimal decisions. Once others have decided on a specific strategy level, it is optimal to conform to it, even if a suboptimal equilibrium is thus attained. A coordination failure then arises, because "if there was a mechanism for agents to coordinate their activities, they could achieve a better (cooperative) equilibrium" (Cooper and John, 1988, p.448). It is exactly the absence of such a coordination mechanism that makes the theory of coordination failures relevant in a monetary economy, because in an economy with a coordination mechanism, such as the Walrasian auctioneer, money is redundant. However, at the other hand, the theory of coordination failures does not give any clue as

to why prices are set in terms of money. It is can only be used for explaining nominal price rigidity if the additional assumption is made that prices are expressed in terms of the monetary unit. In essence, the theory of coordination failures is a theory of real economies (Garretsen, 1992, p.59). So, for the purpose of this thesis, the New Keynesian theory of coordination failures does not explain why particularly prices in terms of money are rigid, but it highlights the coordination problems that exist in a monetary economy, that is, an economy where prices are set in terms of money. Therefore, the link between price stickiness and coordination failures may still be a useful building block for the thesis.

In contrast to this theoretical deficiency, two practical arguments are in favour of the theory of coordination failures. The first advantage is the ease of combining the general idea of coordination failures with other theories, such as game theory, overlapping generations models and sunspots. The second advantage is the realistic account that is given of decision problems in which price setting agents may find themselves. An illustration is given in Blinder (1991a, p.17), who reported that many firms who were interviewed in the study, acknowledged the difficulty of coordinating price changes. In a situation that called for price changes, they said they waited until a first-mover adjusted prices and then all followed quickly. So, in real-world situations, coordinating price changes may lead to a Catch-22 situation. Other examples can be found in demand externalities which may cause the economy to remain in a low-level equilibrium (Cooper and John, 1988, p.454) and local agreements concerning the closing times of shops or the timing of price discounts. Although coordination problems are relevant to a monetary economy because of uncertainty with respect to other agent's actions, the above theory on coordination problems is of little help in understanding pricing behaviour within such an economy. Therefore, other theories on pricing behaviour are discussed, which may be complementary to the theory of coordination failures.

3.3 Cost-based pricing and mark-up pricing

The notions of mark-up pricing and cost-based pricing are different, but related. They are similar in that they can be both captured in the following pricing equation by Kalečki:

$$p = mu + n\bar{p}$$

where p is the firm's price,
u is the firm's unit prime cost,
m is a positive coefficient which reflects the mark-up,
$\bar{p}$ is the weighted average price of all firms producing 'similar' products, and
n is a positive coefficient which reflects the influence on price of the interdependence of firms within an industry.
For an elaborate discussion on this equation, see Kriesler (1987, pp.65-68).

From this equation it follows that price movements may be caused by several factors. The second part of this equation refers to interdependencies in price setting behaviour, which are discussed in section 3.5. The first part of the equation indicates that price changes can result either because of changing costs (u) or because of changing market power (reflected in m). Cost-based pricing and mark-up pricing theory deals with both aspects, respectively. In this section, both causes will be discussed in turn.

Cost-based pricing is assumed to hold in competitive industries. Here, competition rules out mark-ups, because competitors underbid each other until prices equal costs. Discussions on cost measuring are left aside, because they are only relevant here as one of the many ways in which a lack of information may be felt. Okun (1981, p.153) underpins costs-based pricing by arguing that price increases based on cost increases are considered fair. Firms have an incentive to make their customers expect them to apply cost-based pricing, because it makes their customers accept price increases. The price they pay for this reputation is their abstinence from the possibility of price increases in case

of demand shocks. As long as price increases are perceived as 'unavoidable' because of costs increases, customers will expect all prices in the industry to rise and therefore consider it useless to try other suppliers and thus incur search costs. Cost-based pricing can even become institutionalized, as Okun illustrates by referring to broker fees that are a standardized fraction of the costs brokers make, and public utility companies who are sanctioned to bill their customers until they have covered their costs.

These inferences made on the basis of cost-based pricing can be tested. First, data can show whether or not all prices in an industry do rise at the same time. Second, it can be investigated whether cost shocks have a larger impact on prices than demand shocks. With regard to the first implication, Kashyap (1995, p.263) found evidence from retail catalogues that price changes of similar products were asynchronized. Although the moments of price changes sometimes were synchronized, like the moments of issuing new price catalogues, still the amounts of price changes differed to such extent, that cost difference could not explain them. As for the second implication, Blinder (1991a, 1991b) found mixed evidence. At the one hand, firms reported that costs-based pricing was important to them. At the other hand, firms did not respond faster to cost shocks than to demand shocks (1991a, p.15). This implies that cost-based pricing does explain part of prices movements, but not all of them. The fact that only prime costs are taken into account limits the explanatory value of cost-based pricing theory as well. For instance, costs of research and development and other investment costs are neglected altogether. Besides this, costs are related to demand to the extent that they are inventory costs (Carlton, 1989, p.934). Further, the particular unit of account does not affect pricing decisions, so that the theory of cost-based pricing is of limited relevance in explaining nominal rigidities.

Mark-up pricing has to do with imperfect competition: the mark-up factor reflects the competitiveness within an industry. A higher degree of

competitiveness indicates a lower mark-up, as seems to be supported by empirical studies (Martins *et al.*, 1996). This implies that less competitive industries allow for higher mark-ups because the threat of undercutting is less severe. However, the opposite may also be true. In a highly competitive industry, the costs of comparing prices are high, which allows for mark-ups, while in relatively concentrated industries the cheapest supplier is easily identified. In other words, both market power and information costs allow for mark-ups, with opposite implications. This makes the data on market power and mark-ups hard to interpret. As mark-ups can be adjusted to cost or demand conditions, they can result in nominal price rigidity. In this way, mark-up pricing intends to explain nominal price rigidity, but the paradox just sketched out makes the relationship hard to establish via a correlation with market power. Still, Carlton (1989, p.922) finds a positive relationship between industry concentration and price rigidity. This result can be explained either by posing that concentrated firms can adjust their mark-ups m in order to compensate for changing costs, or by referring to pricing interdependencies n, which only allow firms to deviate little from the prices of others reflected in $\bar{p}$. An indirect reference to mark-ups is made in Carlton (1989, p.942) where the difference between the firm's price and its production costs influences the quantity produced. If this difference, being the mark-up, is large, then much is lost in case of excess demand, because potential buyers have to be disappointed. Then, rationing demanders is relatively costly in terms of profit foregone and relative inventory cost are lower as compared to a situation with low mark-ups. The risk of lost profit opportunities induces suppliers to produce relatively large quantities at the risk of having to keep inventories. In these industries, demand shocks are absorbed by inventory adjustments. Therefore, demand shocks may be less important to price movements than are cost shocks, though Carlton finds that price-cost margins in concentrated industries are procyclical (*ibid.*, p.922). However, margins could as well be counter cyclical because relatively low prices in boom periods may deter cheating of oligopolists (*ibid.*, p.929). In a

boom, undercutting one's competitors by lowering one's mark-up is relatively easily compensated for by higher quantities sold, while in a recession cheating is less attractive. So, the relationship between mark-ups and the business cycle is ambiguous. Another argument for anticyclical mark-ups is derived in a model by Stiglitz (*op.cit.*, pp.832-3) and can be recapitulated as follows. In the model, increasing mark-ups in recessions and decreasing them during booms provides an incentive for maintaining quality. This result is based on the assumption of different discount factors (δ^i,δ^j) in both phases (i, j) of the business cycle:

$$V^i = \pi^i + \delta^i(\alpha V^i + (1-\alpha)V^j).$$

The formula shows that the value V^i, being the present discounted value of profits of the firm in state i, equals the profits in state i (π^i) plus the value of future profits, discounted by a state dependent discount factor δ^i, and weighted with the probability (1-α) of a switch of state. The analogous formula holds for the profits of the firms in state j, with discount factor δ^j. If state i is a boom and state j is a depression, then the discount factor $\delta^j < \delta^i$, so that future profits are relatively strongly discounted in booms, as booms are expected not to last. In order to maintain the same value, that is, $V^i = V^j$, present profits must satisfy the profit condition $\pi^i > \pi^j$. If this condition is satisfied, the present discounted value of profits remains constant, so that firms are induced to maintain a high quality level at both stages of the business cycle. The profits in the present period can be kept high enough by cheating, so that production costs are lower, or by raising the mark-up, and therefore the price. In case the mark-up can be adjusted, cheating is less likely to occur. This makes prices and profits per unit anti-cyclical and may thus explain price rigidity.

To summarize, the theory of cost-based pricing and mark-up pricing provides some insights in the way sellers use their discretion in price setting. However,

the empirical implications remain ambiguous. This makes the theory of little use for explaining observed price rigidity. It is even less suitable for explaining nominal price rigidity, because the fact that prices are expressed in terms of money is irrelevant to the theory.

3.4 Administered prices

In 1935, G. Means launched the theory of administered prices as an underpinning of the role of price rigidity in explaining inflation. Means defined administered prices as follows:

> "[An administered price] is a price set by administrative action and held constant for a period of time. We have an administered price when a company maintains a posted price at which it will make sales or simply has its own prices at which buyers may purchase or not as they wish." (Stigler and Kindahl, 1970, p.12)

The theory claimed that prices are not determined by supply and demand but set by firms according to a formula. The theory was applied for two periods, being the Great Depression of the 1930's and the beginning of the 1950's. Means illustrated that, during a recession, industries with a low number of price changes faced larger decreases in output than firms with flexible prices (Stigler and Kindahl, 1970, p.12). Price data like that of Stigler and Kindahl (1970) can be seen as support for the administered pricing thesis. The method that was used by Means has been subject to many criticisms (Stigler, 1968, pp.235-8). One point of criticism holds that the use of data from the U.S. Bureau of Labor Statistics, in which price discounts are not recorded, influenced the outcome. This makes the theory less plausible and difficult to test empirically.

The theory of administered prices is related to mark-up pricing to the extent that both types of pricing strategies may be easier to follow in markets with only few competitors. Administered prices can be compared to market prices, which do result from the interaction between buyers and sellers.

Administered prices	*aspect*	**Market prices**
fixed / sluggish	*degree of price flexibility*	flexible
inventory	*direction of adjustments*	price and quantity
customer markets	*type of market*	auction markets
suppliers / manufacturers	*price setters' identity*	brokers / auctioneers
industrial manufactures	*typical market examples*	stocks, bonds, wheat
differentiated	*type of products*	homogeneous
continuous	*transaction characteristics*	fixed location & time period
bilateral / 'personal'	*trading relation*	atomistic / anonymous

Table based on Domberger (1983, p.23)

From this table, it can be inferred that the theory of administered prices is better suitable for explaining price rigidity than (standard) market prices theory. What is not clear from this table, but is important in the theory, is the collusion that exists between the oligopolists who administer their prices. The tighter the collusion, the more resistance to price changes. Even in cases of cost changes or changes in markets conditions or product specifications, the resistance against breaking the existing price arrangement may be large because of the uncertainty this may create. The costs of haggling about the new pricing schedule will often be larger than the gains of price adjustment to new circumstances (Stigler, 1968, p.216).

The theory of administered prices is relevant for explaining nominal price rigidity, because administered prices are explicitly set and communicated in terms of a unit of account. This feature may result in nominal price rigidity because changes in the monetary aggregate are less likely to be reflected in adjustments of administered prices than they would be in market prices. A drawback of the theory of administered prices is the limited number of

determinants for price setting behaviour it allows for. In fact, only market concentration at the suppliers' side is taken as an explanatory factor of price rigidity. By implication, the theory does not deal with the macro-level, nor does it take the interaction between the supply and demand side of markets into account. Okun's theory of customer markets is broader in scope, and therefore better suitable to capture the many factors that are involved with price setting. Therefore, to put administered prices and customer markets together as in the table above, more reflects Domberger's view than that of Okun. A comparison of both theories is given in Okun (1981, pp.174-8). Several aspects of the customer markets theory will appear in the next section, together with other studies that deal with these aspects.

3.5 Alternative explanations of nominal price rigidity

In standard economic theory, prices are seen as functions of supply and demand conditions. Since supply and demand change frequently, this viewpoint is of little help in explaining price rigidity. In such setting, nominal price rigidities have to be explained from impediments to price adjustments, like menu costs or coordination failures. Other theories start from the market structure in which prices are set, so that prices reflect market power at the supply side. In this section, two complementary strands of theory are reviewed. Firstly, theories that stress the role of prices in trading relations between suppliers in a market and between firms and their customers are discussed. Secondly, theories that consider prices as a means for communicating information are put up.

3.5.1 Nominal prices support relations

In section 3.2.2 the equation by Kalečki was given. Here, its second part is relevant. It says that a firm's price is partly determined by "the weighted

average price of all firms producing 'similar' products" (Kriesler, 1987, p.66). The method of weighing suggested by Kalečki poses several difficulties, which are described by Kriesler (*ibid.*). The weighted average price is multiplied by a factor n which "reflects the influence on price of the interdependencies of the industry" (*ibid.*, p.68). These very interdependencies are relevant, because they reflect coordination problems within an industry. For instance, strategic pricing behaviour occurs whenever price changes by one firm results in price changes by others, so that total demand for the product changes as well. In practice, these coordination problems do exist, as Blinder (1991b, p.95) found in his interview study. Coordination problems as described in the New Keynesian theory of coordination failure[3] were recognized as a highly relevant factor in the pricing decision by many managers, who said they waited with changing prices until others did so and, if they did, soon followed suit. Although coordination is not the ultimate aim of these firms, their behaviour resulted in coordinated price movements. Situations in which coordination is the explicit aim are often found in cartels and can possibly be captured under the heading of administered prices. Tacit coordination plays a role in some sectors, but not in all. For instance, Lach and Tsiddon studied supermarket prices and found that "stores do not coordinate the timing of their price changes, not even implicitly" (1992, p.372). From this lack of synchronization of price changes, the authors inferred that price changes must be relatively small in order not to lose customers to competitors who have not yet changed their prices. This inference is confirmed by their data. It implies that monetary shocks are transmitted incompletely, which can be seen from the distribution of real prices (*ibid.*, p.384). This transmission of shocks also depends on the (technological) interdependency of firms, that is, on their input-output relations (Domberger, 1983, p.127).

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[3] An example with regard to duopoly price-setting is given in Hargreaves Heap (1992, pp.120-125).

As for the role of prices in the relationship between firms and their customers, more literature is available. Most research is somehow related to Okun's customer market theory, but not all results confirm its theses. The more anonymity in the market, as for instance with many new market entrants or customers that often switch, the more the price mechanism is used as an allocation device (Carlton, 1989, p.940; see also the table in section 3.4). This idea can be generalized to markets for new products, in which buyers and suppliers cannot rely on existing trading relationships, and to markets for long-lasting durable goods, which are bought only a few times in a life-time and usually at different places of living. Examples of the former type of products are consumer electronics, like computers, and examples of the latter type of products are washing machines or bicycles. Still, even in these sectors, suppliers try to establish a trading relationship by offering after-sales services. If long-term relationships between suppliers and demanders exist, then stable prices may support these relationships. After-sales services and stable prices can both be interpreted as a commitment to the relationship and an investment of the firm in the trust given to it by its customers. This trust can be seen as a stock quantity and is referred to as a type of capital that is built up within a transaction relationship between buyers and sellers (Carlton, 1989, p.920). In contrast to the table in section 3.4 above, this 'relationship capital' may also be built up in markets for homogeneous goods: if the goods are homogeneous, then sellers may have an incentive to stress their own unicity by investing in a relationship with their buyers. This interpretation of the idea of customer markets can be connected with the notion of implicit contracts, which also stems from Okun. The theory of implicit contracts is described as follows: "firms with no explicit contractual obligations nevertheless act, in the pursuit of long-term profitability, to fulfill certain general commitments to their employees" (Pechman, 1983, p.120). Although this description deals with firms and their employees, its general idea can be applied to customers as well. As Okun formulates the idea:

> "...implicit contracts or conventions [that] introduce a concept of fairness in the relations between suppliers and customers whereby price increases based on cost increases are generally accepted as fair, but many that might be based on demand increases are ruled out as unfair." (Okun, 1981, p.170).

Blinder found that a large fraction of the managers he interviewed support this 'invisible handshake' theory as an explanation of their prices' rigidity (1991b, p.95). Keeping prices at the same level may also prevent customers from substituting away from the product because they then consider the price to remain at this level in the future as well (Carlton, 1989, p.930). However, Stiglitz (1989, p.833) points out that long-term contracts, either in implicit or in explicit form, do not determine the allocation at markets as long as spot prices are flexible enough to clear them. Many managers reported to Blinder that even if contracts specify nominal prices, discounting is a common practice (Blinder, 1991b, p.95). Carlton's (1989, p.920) observation that many explicit contracts do not specify prices nor quantities can be added to this. Both arguments undermine the implicit contracts theory of price rigidities. Unfortunately, Okun does not give empirical support to his thesis, but only discusses its general aspects (Okun, 1981, pp.151-153). For instance, fixed-time scheduling and prenotification are means by which sellers invest in their relationship with customers. In case fixed-time scheduling or prenotification is too risky for a firm, it may promise to meet competition by following competitors' price changes, so that a price-price standard results. If buyers know in advance the time period during which a price offer holds, receive notice before prices will change, and can be sure of a competitive price, respectively, they may remain loyal to their specific seller. In this way these three pricing strategies can explain price rigidity. Besides, a price-price standard goes well together with the interdependencies mentioned at the beginning of this section.

3.5.2 Nominal prices as information carriers

A hypothesis that is intuitively plausible, but is hard to underpin theoretically is the hypothesis that prices signal quality characteristics of a product (Stiglitz, 1987). The intuition may be that high quality goods are costly to produce and therefore call for high prices. It may be questioned whether customers perceive prices as such, since managers seldomly think they do. This is relevant with regard to price changes: are they to be interpreted as changes in quality? Blinder found that only few managers think so and act accordingly by keeping price changes to a minimum. All others rank this hypothesis as "totally unimportant" (Blinder, 1991b, p.96). Stiglitz (1989) shows that prices are poor quality indicators. A low price is correctly perceived as an indicator of low quality, but a high price may be caused either by the high costs of producing a high quality product or by an attempt of a low quality producer to imitate a high quality product and reap the benefits of a high margin, even at the possible expense of a lower sales volume. These volume losses are determined by the possibility of quality detection, the sensitivity of groups of customers to quality differences and the possibility to discriminate between groups of customers on the basis of this sensitivity (Stiglitz, 1989, pp.839-842). Thus, high prices are an unreliable indicator of high quality. For markets with asymmetric information, this point was convincingly made by Akerlof (1970). Still, prices serve as a signalling devise to build up and maintain a reputation. This makes prices at least stickier in the downward direction, even in a recession or in case a new production technology allows for lower prices by lowering production costs (Stiglitz, 1989, p.825). Thus far, the argument holds for real as well as nominal price rigidities.

Prices may supply information in quite a different way as well. Here, their being nominal prices is essential. Nominal prices make calculations easier than real prices do. A funny example of this is given by Okun, who describes his fellow economists' unawareness of the consumer price index movements when they tried to calculate the movements in their real salaries during the last

years (Okun, 1981, p.287). This example illustrates that people are used to thinking in nominal terms. Sellers not only recognize this with regard to their buyers, but do so within their firm as well. Because of information costs, prices can also be seen as a 'product of an information system' within the organization (*op.cit.*, p.170). Okun argues that it is wrong to describe thinking in nominal terms as money illusion: nominal prices are a mere language to communicate by, just like Britains or Americans are not subject to "English illusion" (*ibid.*). Hoogduin even calls the assumption that people think in real terms a "real illusion" (Hoogduin, 1996, p.10). The assumption neglects the fact that people use money as a unit of account in order to keep a sense of relative prices without having to perform more calculations than they are able to (*ibid.*, p.5-6). Kashyap finds that retail sellers recognize this and adapt their price setting behaviour. For instance, they do not adjust their catalogue prices with every new catalogue because of "the confusion it would create for customers," even though this may be optimal from an allocation point of view (Kashyap, 1995, p.263). Then, they take into consideration the convenience created by not updating prices with inflation, so that customers can use 'rules of thumb' while comparing prices (*ibid.*, p.266). The prices of some products are more explicitly used as such than others. For instance, boxes of cigarettes and loaves of bread have such a 'habit price.' Another example of a reference price is the price of gasoline, especially because of the rumours that arise when these prices change frequently, as in times of oil shocks. Firms may also exploit this feature of their customers' psychology by using pricing points:[4] they choose to set prices just below such points, thereby having prices end with digits 95 or 99.[5] In Blinder's

[4] Blanchard and Fischer consider the reference to focus point pricing by Kashyap as rather different from the theories of nominal rigidity they discuss (1989, p.423, fn.53). One of the reasons for the difference may be that Kashyap takes the fact that agents calculate and communicate in terms of money seriously.

[5] This example only holds in countries with decimal currencies. In countries with duodecimal currencies, like Great Britain was before 1971, prices ending with 5 or 11 are pricing points. It is interesting to note that the official conversion table used in

survey, managers responded to this theory by accepting it, but they doubted whether it also served as an explanation of price rigidity (Blinder, 1991b, p.95). Indeed, there is a difference between 'psychological price setting' and not crossing borders to a higher price. For example, the fact that a price of 499 is perceived differently as compared to a price of 501 does not imply a rigidity towards adjusting it to 599. It does, however, implicate that once a price is adjusted, it is adjusted to another pricing point instead of a price in between two pricing points. In the example, a price will be likely to remain at 499 for a relatively long time and then be adjusted to 599 instead of gradually climbing up to this level via, say, 525, 560, 585 or so. It may also be the case that price increases retard when prices reach a price point, 'jump over' the pricing barrier, and resume their speed of increasing until a new price point is reached. In both cases, staggering prices may result. Implications like these can be tested empirically. Kashyap tried to do so without falling prey to the danger of circularity that arises when pricing points are identified from the same data their existence is tested with (Kashyap, 1995, p.267). To break this circle, pricing points have to be defined in advance, by posing thresholds. For instance, prices that ended between .75 and .99 were considered pricing points. Two hypotheses could be tested: first, price increases will be relatively large given that they have been held up longer because of the price barrier just above the pricing point; second, the probability that a price will rise is smaller when this price is nearby a pricing point than in case the current price is further away from a pricing point. The first hypothesis was affirmed with statistical significance, though it must be remarked that the same effect can also be caused by the existence of

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Great Britain during the changeover to the decimal currency system (Moore, 1995) was, perhaps intentionally, designed in such way that the old pricing points could also be recognized as such in the new system. The conversion table reveals that prices in between two pricing points, ending with 2 and 3, and with 9 and 10, became indistinguishable in the new system. The distribution of the last digits of duodecimal prices may explain why the grouping together of old prices is not the same in the 0-6 range as compared to the 7-12 range.

menu costs (*ibid.*, p.267). The second effect could only be confirmed for the direction of expected price changes, but not significantly (*ibid.*, p.268). That is, many other factors, like costs increases, also influenced the pricing decision, thereby mitigating the influence of pricing points. Further, it turned out that pricing points are more relevant in times of low inflation than in times of high inflation (*ibid.*, p.268). This may point toward interdependencies in price setting: sellers dare to raise prices beyond a price barrier in times they are rather sure their competitors will do so as well. In terms of the suppliers' revenue curves, it can be hypothesized that these curves may be less sharply kinked at a pricing point in times of high inflation than in times of low inflation (*cf.* Kashyap, 1995, p.265). In high inflation periods, customers may have lost their reference points anyway, which provides an opportunity for sellers to set new prices without losing customers. Remarkably, the possibility that during times of high inflation the need for reference points increases so that nominal prices become more rigid than during times of low inflation is not taken into account. This may be so, because the need for reference points is a collective one, whereas the profits of adjusting prices accrue to the individual price setter. Thus, an externality is involved, which can be internalized by price regulations, as governments often issue during times of high inflation, *e.g.* for bread.

The concept of reference points is closely related to another psychological phenomenon: framing. Framing refers to the way people interpret information by placing it within their frame of knowledge and understanding of the world around them. If the new information fits well into their frame, they will accept the new information as plausible. Otherwise, the frame is redesigned[6] or the information is rejected as unacceptable. Information can be rejected as unacceptable because it is considered unfair. With regard to prices, customers compare a price increase to other information on prices and

[6] To redesign a frame is also referred to as 'second level learning', 'representational redescription' and 'double loop learning' (*cf.* Argyris, 1977; Denzau and North, 1994; Nooteboom, 1996).

price increases and then judge the outcome of this comparison as 'fair' or 'unfair.' Examples of 'fair' price setting are given by Okun, who ventures that price increases because of cost shocks are considered fair whereas prices increases because of rising demand are only considered fair in some sectors. Peak-load pricing in the utilities and transport-sectors and hotel prices that change according to expected demand that is related to events in a particular town are examples of the latter. In other sectors, waiting lists are customary, as with automobiles, or sold-outs, as with sports and music events (Okun, 1981, p.170). Strictly speaking, if cost-based pricing is considered fair, this might influence both the empirical relevance of customer market theory and the theory of cost-based pricing, simultaneously. In Blinder's survey, the percentage of managers that subscribe to both theories is about equal (Blinder, 1991b, table 2). Inspired by Okun's notion of fairness, Kahneman *et al.* set out to find these standards of fairness and thereby revealed much of the frame customers use when judging pricing information (Kahneman *et al.*, 1986). Their experiments with people's reaction to proposed price changes revealed that reference points indeed play a major role. Transactions are compared to transactions with other parties in the same sector, with earlier transactions with the same partner, and with posted prices in the sector. The 'dual entitlement hypothesis' captured the observation that both customers and suppliers consider themselves and each other as entitled to a reference gain: the supplier is entitled to a reference profit and the costumer is entitled to a reference price. The former leads to acceptance of price increases in case of cost increases, whereas the latter leads to opposition against price increases that result from demand increases or shortage. Further, framing plays an important role in the judgement of price changes. As was mentioned earlier in the description Okun gave of his colleagues, nominal price changes are seldomly calculated into real price changes by taking into account the inflation rate. With regard to wages, this is even more clearly so. Nominal wage changes are perceived as 'fair' or 'unfair' by simply comparing them with previous nominal wages and judging

any nominal wage cuts as unfair (*ibid.*, p.731; *cf.* Hicks, 1946, p.265). The implications are fourfold. First, markets are less likely to clear if only demand rises than in case costs rise as well, because this makes price increases more likely to be accepted by the customers. Second, price discrimination because of different demand elasticities are likely to be considered 'unfair', so sellers often resort to quantity rationing and inventory adjustments. Third, prices may be more flexible upward than downward, though this implication remains unsettled. Fourth, price decreases often take the form of discounts instead of lower list prices, since list prices easier become reference points. Kahneman *et al.* conclude by posing that firms are very keen on living up to their reputation of being 'fair.' Customers feel the same, since monitoring the firm is very costly to them. The customers must gather both information concerning the reasons for a firm's price increase and information of the firm's competitors' prices (Hargreaves Heap, 1992, p.121). In situations in which these costs are high, trust and reputation are most relevant. The fact that prices are set in terms of money is also relatively important, because this reduces calculation costs. In markets for new products, a frame of reference is lacking. This implies that prices can be more flexible, particularly if costs are changing as well. For instance, in the market for personal computers, costs are decreasing fast and new generations of computers follow up, soon. At the other hand, the relationship between the seller and the customer has to be established, which makes suppliers cautious not to raise prices in a way that may be considered 'unfair' by their customers.

Nominal as well as real prices can communicate information both by their flexibility and by their rigidity. For instance, flexible prices can communicate changes in demand, production costs, or profit margins. Moreover, rigid nominal prices can communicate a seller's intended reputation, a seller's commitment to 'fair' prices, or a sensitivity to frequent nominal price changes of the customers. The latter is important in case of 'habit goods', which function as an anchor for expectations concerning other prices. In these cases, price flexibility, albeit as often downward as upward, may be rejected by

customers because they lose their guidance. Even though today's price may be optimal, tomorrow's price becomes highly unpredictable. A historical example is the oil crisis, during which the price of benzine was adjusted daily. The volatility of prices increased efficiency, as the gasoline prices reflected costs, but uncertainty increased as well. This example illustrates that in a 'price tag economy', some degree of nominal price rigidity is valued as such, because it facilitates transaction decisions. In other words, not only do nominal prices reduce the number of calculations to be made, their rigidity also contributes to cheaper transactions given the uncertainty inherent to a monetary economy.

3.6 Assessment

This chapter discussed theories which aim to explain nominal price rigidity. New Keynesian price theories deviate from the neoclassical framework because they assume market imperfections, which allow for price setting behaviour. The assumption of rationality in terms of optimizing behaviour is maintained. Several New Keynesian explanations were discussed, like menu costs, time dependent and state dependent price rules, staggering, and near rationality. Apart from their common assumptions, they also had another aspect in common: in order for price adjustments to be optimal, they had to be coordinated upon. From this point of view, they are shortly summarized here.

The discussion on staggering prices revealed that the decisions of price-setters on when to update their prices may be interdependent. The two directions of interdependency run as follows: the more agents change their prices, the costlier it is for an agent not to follow suit, and if one agent changes his prices, he decreases the costs of changing prices for the other agents. In other words, price setting behaviour is subject to strategic complementarity and spillovers, respectively. This conclusion was also derived from the argument about near-rationality and menu costs. The same holds for synchronized equilibria, in which the only reason for price setting firms to change their prices

is the fact that other firms do so as well. For instance, if one firm raises its prices, demand for the output of the other firms increases and makes them want to rise their prices as well. Then, firms only raise their prices shortly after one another and so move from one equilibrium to the next, without deviating at moments in between the common price increases. Synchronized equilibria differ from staggered price setting, because in synchronized equilibria no prices change, whereas in staggered price setting situations some prices change and some do not (Rotemberg, 1987, p.90). If staggered price setting evolves towards bunching behaviour, synchronized equilibria occur. Then, the moment of changing prices has to be decided upon collectively, even if communication facilities may be lacking. In a word, uncertainty and the coordination problem, albeit in different forms, remain central to understanding nominal price rigidity.

The notion of coordinated price changes can be combined to the customer markets' point of view, as was first expressed by Okun (1981). In customer markets the sellers are price setters and the buyers are price takers, just as in the New Keynesian theories cited above. Okun uses the term multiple equilibria in a different sense, namely for indicating that price setters can choose between either low prices and high sales rate or higher prices and lower sales rate. Both options are optimal, in contrast to the New Keynesian theory in which the equilibria can be Pareto-ranked. However, once a supplier has chosen one option, it is optimal to stick to it, because their reputation among customers is built. Search costs make customers stay with suppliers they consider attractive, instead of investigating all suppliers' prices every time they want to purchase. This effect may become even stronger once prices are supposed to indicate the presumed quality of the product (*cf.* Stiglitz, 1989). If a shop has a reputation of being exclusive and supports this reputation with high prices, discounting may become incredible and distractive to its clientele. Although at this stage the argument is not very straightforward, this example points to the possibility of a price setting convention that is based on the non-quantifiable

aspect of a reputation of exclusiveness, which is supported by use of the price as an instrument of communicating this reputation. In the next chapter the lack of a causal relation between the factor that causes price changes and factors that determine profit, is captured under the heading of focal points. The Sunspot theory that was introduced in the section on Overlapping Generations Models in the former chapter can be interpreted as a special case of focal points in expectations formation.

Fairness may also contribute to an explanation of nominal rigidities in price setting behaviour. It does so, if suppliers and demanders agree on factors that lead to a fair price increase and factors that do not. A famous example is found in the price of snow shovels: interviews reveal that many people consider it unfair to raise the price of snow shovels after a snowstorm (Kahnemann *et al.*, 1986). Given this shared opinion on fairness, a rational supplier of snow shovels will not increase his prices, even though this may be profitable because demand has risen and his supply is limited. So, here again price rigidity seems compatible with rational, optimizing behaviour. At the same time, rationality is insufficient for explaining actual behaviour, as the concept of fairness seemingly contradicts optimizing behaviour. Instead, the notion of reference points goes well together with rationality as far as price setters are concerned. Given that prices are expressed in some commonly used unit of account, and agents perceive nominal prices and price intervals differently according to their position with respect to pricing points, it is rational to take these facts into account while setting prices. Although the subjective perception of reference prices is hard to explain from rationality, theorizing along the lines of such framing behaviour can contribute to explaining nominal price rigidities.

The next chapter scrutinizes situations of coordination problems. It will be derived that conventions and institutions may contribute to solving a coordination problem. In the situation of multiple or synchronized equilibria, a convention may exist that indicates the moment of price changes. In case price setters only want to changes their prices if others do so, they profit from

adhering to such a convention. This latter aspect of conventions implies that convention shifts seldom do occur, so that price setting behaviour may be subject to a regularity. A characteristic feature of conventions is that this regularity is not necessarily compatible with individual optimizing behaviour at every moment. However, the conformity to conventions can be explained from long-term optimizing behaviour, given that coordinating price changes is more profitable than not doing so. The same holds for institutions, like binding rules which govern price changes. Institutions of this kind are common in the labour market and in other markets in which prices are regulated by government or by the suppliers themselves.

From this line of reasoning, the contours of the main argument evolve. The relationship between the use of money and nominal price rigidity may stem from their common source: both phenomena serve as a means of coping with uncertainty and coordination problems.

4 Conventions and Institutions in Coordination Problems

4.1 Coordination Problems and Game Theory[1]

In an economy coordination problems arise in cases of multiple equilibria. Agents who, because of incomplete information, have to take care of coordinating their actions, can but act on their expectations of other agents' actions. As these other agents act on their expectations as well, decisions become interdependent. In this way, multiple equilibria may result, depending on the level of mutual expectations. Situations of multiple equilibria leave the question unanswered as to how a particular equilibrium is selected, *i.e.* how do the agents coordinate their actions in order to reach a particular outcome? (Cooper and John, 1988).

In the former chapters several instances of coordination problems were discussed. The chapter on money gave examples of the selection of a medium of exchange and a unit of account. Both functions of money are subject to network externalities, as they do better the more agents make the same choice. The impact of fundamental uncertainty, which was shown to be inherent to a monetary economy, creates many coordination problems of its own, since the need to form expectations on other agents' actions is greater once these actions are not known beforehand and no probability distribution of possible actions can be made. The chapter on price rigidity argued that many nominal pricing decisions are subject to interdependencies. Once agents are able to set their prices, it follows that the market structure creates room for strategic behaviour. Pricing decisions by one supplier trigger reactions by others as well as reactions by customers. Nominal prices which remain unchanged for some time contribute to the information agents need in order to form their expectations. The fact that these prices are calculated

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[1] Most of this chapter has been published as Van der Lecq (1996) and is reprinted courtesy of Kluwer Academic Publishers.

and communicated in terms of a common unit of account contributes to lowering information and transaction costs, but causes framing effects and reference points as well. To sum up, coordination problems abound in a monetary economy.

The game format provides a useful tool for analysing interdependent decisions and interactions, because it explicitly describes the alternative choices of individual agents as well as the payoffs that result from the combination of choices made by the players of the game (Kreps, 1990). "A game is a situation in which a number of individuals or players interact, and in which the outcome for each of them depends not only on what he or she chooses to do, but also on what others choose to do" (Sugden, 1986, p.9). As some combinations of choices result in higher pay-off outcomes than do other combinations, games provide an adequate model of coordination problems. A coordination failure is said to be present if "mutual gains from an all-round change in strategies may not be realized because no individual player has an incentive to deviate from the initial equilibrium" (Cooper and John, 1988, p.442). Multiple equilibria often occur in game theory, in situations of indifference between two or more outcomes and a lack of rules determining the equilibrium strategy to be chosen. In other types of games the equilibrium outcome of the game is considered socially unacceptable (Ullmann-Margalit, 1977, p.15).

In order to analyse the way coordination problems are dealt with in a monetary economy, this chapter gives a game-theoretic description of coordination problems and interprets conventions and institutions as ways of coping with them. By way of introduction, conventions and institutions can roughly be described as rules of behaviour in situations that call for coordination. Conventions are often said to be self-enforcing, that is, once they are established, agents tend to conform to them.[2] Institutions enforce compliance to a selected equilibrium by means of a sanction mechanism. In section two, coordination problems are presented in a game-theoretic format.

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[2]Whether or not they really are self-enforcing is discussed in section 4.3.

Three types of games are discussed, those being (pure) coordination games, prisoners' dilemma games and mixed motive games. It is argued that game theory needs expansion beyond the mere construction of equilibria in order to contribute to an explanation of the societal selection of specific equilibria, such as, for example, the production level of an economy. The present chapter does not intend to give an extension to game theory. Instead, an informal description of a complementary equilibrium selection mechanism is given, in which conventions and institutions contribute to solving coordination problems. Theories developed to explain the process by which conventions come into existence are discussed in section three.

There are four assumptions of game theory which not only limit the applicability of game theory to coordination problems but also any combination of game theory with other theories that together aim at explaining the existence of conventions. These assumptions are instrumental rationality, methodological individualism, the state-of-nature and the amount of information players are assumed to possess. Instrumental rationality implies the selection of actions by agents according to the criterion of their contribution to the agents' utility, that is, an optimal use of means to realize ends (Hargreaves Heap, 1989, p.39). An instrumentally rational agent will always use possibilities to increase his profit or utility. Often, the assumption of common knowledge of rationality is made as well, which not only holds that each player is instrumentally rational, but that each player knows (that each player knows that ... and so on) that each player is instrumentally rational (Hargreaves Heap and Varoufakis, 1995, p.24). Explaining group behaviour by analysing individual decision processes is called methodological individualism. This approach has the advantage of separating rules of behaviour from actors, that is, rules are not considered as entities (Janssen, 1993, p.xiii). They are the result from agents' interactions, but do not themselves interact with agents. Further, the reduction of the decision process to the individual level gives a clear insight in the extent to which conventions can be explained from this level and the stage at which a model of social interaction is needed (Ullmann-Margalit,

1977, pp.14-17). In evolutionary game theory, two-player games are studied, while these players are seen as members of an *n*-person group. In this way, an economy with repeated bilateral coordination problems is modelled as a population in which some players play one strategy and others play another (Van Damme, 1994, p.848). From the population, a pair of players is randomly and repeatedly matched (Samuelson, 1993, p.214). By thus playing the game many times, a possible convergence to either strategy can be analysed. An extension to *n*-person games is given in Schotter (1981, Ch.3). The assumption of a state-of-nature economy, being an economy without conventions or institutions, is made in order to find out whether games may provide a way of endogenizing the emergence of conventions and institutions from individually rational behaviour (Schotter, 1981). The informational assumption holds that players know the alternative strategy options available to them as well as those of the other player and the resulting pay-offs. In section three, the first three assumptions will turn out to be too restrictive. In section four the relationship between rules of behaviour and information is explored within the context of Institutional Economics. Section five gives examples of conventions and institutions as possible solutions to coordination problems in an economy.

4.2 Coordination Problems in Games

In game theory, two often used criteria for equilibrium selection are dominance criteria and the concept of Nash equilibrium. In a Nash equilibrium each player's strategy[3] is at least as good a reply to the strategy of the other player as are all alternative strategies available to him.[4] For a repeated game this implies that players, once they are in a Nash equilibrium,

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[3] For reasons of simplicity, the remaining text is restricted to pure strategies. A discussion which includes mixed strategies can be found in Weibull (1995).

[4] In a *strict* Nash equilibrium each player's strategy is the unique best reply to the strategy of the other player.

do not want to change their strategy. It is instrumentally rational for them to stick to it, because this maximizes pay-off to them given the strategy of the other players. Pareto dominance and risk-dominance are useful criteria for ranking the equilibria and eliminating some of them, until one or a few remain. A combination of both dominance criteria is given by Harsanyi and Selten (1988), who present a method of equilibrium selection that is claimed to yield a unique outcome in all games. Their method can be considered an extension of the concept of Nash equilibrium (Van Damme and Heertje, 1994, p.940). However, in situations of multiple Nash equilibria, problems arise. As Sugden (1989) points out, if rationality leads to a unique outcome, then conforming to a convention cannot be rational. However, "if it can be rational to follow a convention, the claim that every game has a unique rational solution must be false" (Sugden, 1989, p.86; *cf.* Furth, 1989; and section 4.3). An extension of the Nash equilibrium concept may therefore be insufficient to guarantee the selection of a unique outcome.[5] As the selection theory of Harsanyi and Selten rules out all but one of the (strict) Nash equilibria, it cannot rely on rationality alone and has to be based on a theory of behaviour as well, which is external to the game (Rabin, 1994, p.85). Therefore, it can be inferred that games do not always generate one unique equilibrium, nor the outcome with highest pay-offs to the players. This is illustrated for several types of games that model coordination problems.

see overleaf →

[5]Perhaps very strong restrictions on the type of game will do (*cf.* Young, 1993). However, this approach seemingly results in as many refinements as there are Nash equilibria (Binmore in: Weibull, 1995). For a related criticism on refinements of the characteristics of game players, see Binmore and Samuelson (1994).

Games that model coordination problems can be fit in a framework (Vromen, 1995a) in which the generic form and two specific forms look like:

Generic form

	B	
A	y, y	$0, x$
	$x, 0$	z, z

(Pure) coordination game

	B	
A	2, 2	0, 0
	0, 0	1, 1

$y \geq z > x = 0$

Prisoners' dilemma game

	B	
A	2, 2	0, 3
	3, 0	1, 1

$x > y > z > 0$

in which player A can choose between playing 'top' or 'bottom' and player B can play either 'left' or 'right', with 'top' and 'left' indicating the same strategy and 'bottom' and 'right' indicating the same alternative strategy. In all pay-off matrices the pay-offs to player A are given first. In a (pure) coordination problem players need to select the same strategy in order to reach one of the Pareto superior equilibria. If $y = z$, the game is called a pure coordination game, whereas if $y > z$, it is a coordination game. The numerical example refers to a (nonpure) coordination game. In case pre-play communication is possible, players can agree on a strategy. Otherwise, they must conjecture the strategy their opponent will play. In case the game is played repeatedly, players can base their expectations on history and a convention can come into existence, as will be described below. In a coordination game, both players not only prefer any coordination above none, but also prefer to coordinate on one particular strategy combination. In a prisoners' dilemma (PD) game, the Nash equilibrium is Pareto inferior. In a one-shot prisoners' dilemma game the players are inclined to play 'bottom, right' and so end up with payoffs '1,1'. A binding agreement can enforce the strategy combination 'top, left' so that the Pareto superior outcome of '2,2' is realized. If the prisoners' dilemma game is played repeatedly, a reputation of playing a tit-for-tat strategy may serve as an instrument for attaining the Pareto optimal outcome, even if a binding agreement is lacking (*cf.* Furth

(1993); Kreps *et al.* (1982); Rasmusen (1989); and footnote 9). Although reputation building is a phenomenon that can be captured within the game context, it is of little use to us, as reputations can only be built if the game is repeatedly played by the same players. If the players who oppose each other are members of a larger community and seldom meet again, reputation building is fairly difficult. This makes many forms of trade anonymous (*cf.* Sugden, 1986, p.35).

Games can be ordered on a scale ranging from pure conflict games[6] to pure coordination games (Schelling, 1960, p.84). Pure coordination games are exactly identical to the one extreme of the scale. As Lewis defines them: "Games of pure coordination, in which the agents' interests coincide perfectly, are games in which the agents' pay-offs (perhaps after suitable re-scaling) are equal in every square" (Lewis, 1969, p.14). Prisoners' dilemma games are close to the other extreme but not identical with it, because there still is an element of coordination present, as the coordinated strategy 'top, left' yields higher payoffs to both players than the Nash Equilibrium strategy 'bottom, right' does. The degree of conflict dominates the element of coordination, because one-sided deviation from the coordinated strategy by playing 'top, right' or 'bottom, left' results in highest pay-off to the deviating player.

Most games are neither games of pure conflict nor games of pure coordination, but are a mixture of opposition and coincidence of interests (Lewis, 1969, p.14). In between both ends of the coordination-conflict scale,

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[6] Pure conflict games are also called zero-sum games, because the loss of one player is the gain of the other. An example of a zero-sum game is given by Ullmann-Margalit (1977, p.79):

	player B	
player A	1 , -1	0 , 0
	0 , 0	-1 , 1

As these games do not model any coordination problem, this extreme of the scale falls outside the group of presently discussed games.

mixed motive games[7] can be located. Examples of mixed motive games are the following games (Vromen, 1995a):

Hawk-Dove / Chicken game

		B
A	1 , 1	0 , 2
	2 , 0	-1,-1

$x > y > 0 > z$

Battle of the sexes game

		B
A	-1,-1	0 , 2
	2 , 0	-1,-1

$x > 0 > y = z$

Stag Hunt game

		B
A	5 , 5	0 , 4
	4 , 0	2 , 2

$y > x > z > 0$

In order to avoid both the strategy combination 'bottom, right' that results if both players aim at the highest pay-off of '2' but end up with the lowest ones, and to avoid the two Nash equilibria 'bottom, left' and 'top, right' that are only profitable to one of the players, they should coordinate on 'top, left' in the 'Hawk-Dove' game. In the 'Battle of the sexes' game the two strategy combinations of different strategies yield higher pay-offs, but both parties profit differently from either combination.[8] The 'Stag Hunt' game illustrates the situation in which the Nash equilibrium with highest pay-offs to both players is less stable than the Nash equilibrium with lower outcomes, because players who are not sure their opponent will also coordinate on the 'top, left' strategy combination, may be tempted to do their part of 'bottom, right' in order to be secured of a pay-off of at least 2. In other words, the (strict) Nash Equilibrium 'bottom, right' risk-dominates the Pareto superior (strict) Nash equilibrium 'top, left' (Weibull, 1995, p.31). In the remaining text, mixed motive games will be treated as one category. The

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[7] Mixed-motive games are also called bargaining games or negotiation games.

[8] This game illustrates that coordination of actions does not always mean choosing the same action. Put formally, not all coordination games are unanimity games, in which there is positive pay-off only when all players play the same strategy (Furth, 1989, p.737). An example is the coordination of traffic at crossroads, whereby one party gives way to the other.

distinction between the three sorts of mixed motive games is useful for modelling specific coordination problems.

Besides the distinction between coordination and conflict, games can also be divided in cooperative games *versus* non-cooperative games. "If both communication and binding contracts are possible, the game is called a cooperative game; if no communication is possible, the game is called non-cooperative" (Schotter, 1981, p.15). The latter part of the definition stems from the necessity of communication for making a binding contract and so playing a cooperative game.

The distinction between cooperative *versus* non-cooperative games can be combined with the coordination-conflict scale. Wubben (1993, pp.217-223) puts both scales orthogonal to each other, so that a 2x2 matrix results. The four cells of this matrix will be discussed two-by-two. Firstly, in a game with cooperation and coordination, one of the two is redundant. If a binding agreement forces players to choose a particular equilibrium strategy, they need no longer coordinate on it. The other way around also holds: if players voluntarily agree to coordinate, cooperation is needless. This latter view is supported by the findings of Schelling and Lewis, who have shown that an explicit agreement is not a necessary condition for successful coordination by way of a convention (Ullmann-Margalit, 1977, p.76). Secondly, in a game with neither coordination nor cooperation, by definition, a binding agreement that resolves the conflict is not possible. Therefore, it cannot provide for the attainment of the outcome with the highest collective pay-off. The conflict results in a Pareto inferior outcome.[9] It can be concluded that in a cooperative game the presence or absence of coordination does not matter, whereas in a coordination game, a binding agreement is superfluous. This reduces the orthogonal combination of both scales to a uni-dimensional scale, in which the distinction between cooperative and non-cooperative

[9] By the Folk Theorem, a repeated game with infinite time horizon may lead to the same outcome as a cooperative game. However, the situation of two players playing such a game is not likely to occur in economic coordination problems and therefore it is abstracted from.

games runs parallel, though inversely, to the coordination-conflict scale.

coordination	*conflict*
non-cooperation	*cooperation*

(figure 1)

In figure 1 the remaining two combinations are shown. In the third one, situations that call for coordination need not demand cooperation. An example is found in the use of a medium of exchange, because the pay-off in terms of transaction efficiency is higher for all agents if they use the same medium of exchange, but they already tend to do so without the necessity of a binding contract. As will be derived later, conventions, being solutions to pure coordination problems, tend to be self-enforcing, so that a binding agreement is redundant. In the fourth case, cooperation provides for a binding agreement in a problem of conflict. However, instrumentally rational agents will only cooperate for two reasons. Either, they are forced by threat of a sanction to enter one, which leaves the rationale behind the sanction to be explained, or they voluntarily enter into a binding agreement because they profit from it, so that at least a small element of coordination remains, just like in PD-games. In an economy, such situations occur in negotiations, cartels and co-makership relations. Here, the binding agreement acts as an institution: it solves the coordination problem and enforces compliance by the sanctions it contains. As the original four cases are reduced to two, a reduction of terminology is also possible. In the remaining text, the scale of figure 1 is reduced to coordination games at the one side and cooperative games at the other side.

In games the resulting pay-off for individual players depends on the action of the player himself as well as on the action of the other player. Without further additions to the game setting, a one-shot prisoners' dilemma game results in a low total pay-off outcome, a mixed motive game may do so, and a coordination game does not lead to a determinate outcome. These problems cannot be solved within the game. Therefore, a rule for behaviour

that is external to the game needs to be supplied, *e.g.* a norm.[10] A norm is defined as follows: "A social norm is a prescribed guide for conduct or action which is generally complied with by the members of a society" (Ullmann-Margalit, 1977, p.13). According to the type of problem, the norm takes a different form: a convention or an institution. Both types of norms change the pay-off matrix in such fashion that one strategy combination becomes more attractive than others. They will now be treated in sequence.

In a pure coordination game, the aim of selecting an equilibrium is shared by the players and creates interdependency between them. If there is indifference with regard to the pay-offs, so that players do not mind which equilibrium they end up in as long as they end up in one, then players have the common interest of picking out the same equilibrium (Ullmann-Margalit, 1977, p.115). If one of the equilibria is more attractive than others, that is, in a non-pure coordination game with $y > x$, or if the equilibrium solutions clash[11], then coordination is even more relevant. Strategic interaction, that is, the interdependence of strategies, may lead to infinite regress and cause players to make no decision at all.[12] In order to end this stalemate 'something' outside the game should give the players a clue as to what their fellow player will choose to do. Then, a convention that helps players choose one out of some coordination equilibria can function as a coordination norm.

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[10] Of course one can also think of legal intervention or a (benevolent) dictator as *dei ex machina*, but then no further rationale for their existence can be given. From a theoretical point of view, the advantage of a norm is that its existence can be explained without changing the number of decision making agents, so that it is compatible with methodological individualism (see also section 3).

[11] A classic example is the coordination of driving lanes: if one player chooses the strategy of driving at the left-hand side and the other players chooses the strategy of driving at the right-hand side, then both solutions clash (as well as may both players).

[12] 'No decision' can also mean 'no decision to change' so that inertia results. This may occur if producers have to decide whether or not to issue new prices or to change wages. Another example is given by investors who, in situations of uncertainty, may decide not to change their investment behaviour (Keynes, 1936, pp.152-153).

Prisoners' dilemma type of norms make players choose the strategy combination with the highest total pay-off. Because this is not a Nash equilibrium, players tend to deviate and will only comply with it if it is accompanied by sanctions. The sanctions can either function as a restriction on the number of strategies open to the players, for instance by prohibiting the choice of the degenerate strategy combination, or by changing the pay-off structure in such a fashion that the players choose the strategy combination with the highest total pay-off[13] (Ullmann-Margalit, 1977, p.37). Examples of such norms can be found in morality, culture and religion. They evolve in conflict-dominated situations in which the two players are members of a large group of potential players who repeatedly find themselves in a prisoners' dilemma type of game (Vromen, 1995a, p.2).

To sum up, in coordination games, multiple equilibria call for a coordination of strategies, and in cooperative games, total pay-off increases if a binding contract resolves the inherent conflict between players. As mixed motive games are hybrid types of games, the accompanying norms will vary accordingly, with more or less of a binding sanction element included. A line drawn parallel to the one above indicates the accompanying norms as solutions to the respective games:

coordination	- game type -	*cooperation*
conventions	- solution type -	*institutions*

(figure 2)

As in an economy many confrontations are ad hoc and anonymous, an explicit agreement is seldom made. This increases the relevance of studying games with a high degree of coordination, which are posited at the left-hand side of the scale.

The types of norms differ in two respects. Firstly, a prisoners'

[13] A nice example is found in the IMF board, where consensus is an enforceable norm, with voting as the sanction mechanism (Witteveen, 1994, p.1).

dilemma norm is not arbitrary, as only one outcome has the highest total pay-off, whereas a pure coordination norm is. Secondly, a prisoners' dilemma norm is socially first-best, but individually second-best, while a (pure) coordination norm is socially as well as individually first-best in terms of pay-offs (Ullmann-Margalit, 1977, pp.118-119).

Many authors use different interpretations of the terms conventions and institutions. In this book, the framework of terminology is a combination of the one used by Ullmann-Margalit and that of Lewis and Schotter, for two reasons. Firstly, this framework is compatible both with the games presented above and with the (institutional) economics literature discussed in section 4 below. Secondly, conventions and institutions can be clearly distinguished whenever necessary. According to the first author, norms that solve repeated coordination problems can be divided into the class of conventions or the class of decrees:

> "Two types of such norms are distinguished: (1) accepted and established solutions to past recurrent coordination problems which - with time - assume the status of norms; (2) solutions to novel recurrent coordination problems which from the outset are being decreed as norms. The first type is then called 'conventions', the second 'decrees'." (Ullmann-Margalit, 1977, p.76).

The latter type of norms is often called institutions, as will be done in the present chapter, so that unnecessary differences in terminology are avoided. Schotter defines institutions in such a way that conventions are a subgroup of institutions:

> "..social conventions: regularities in behaviour which are agreed to by all members of a society and which specify behaviour in specific recurrent situations" (Schotter, 1981, p.9) and
>
> "A social institution is a regularity in social behaviour that is agreed to by all members of society, specifies behaviour in specific recurrent situations, and is either self-policed or policed by some external authority" (*ibid.*, p.11).

In this study, conventions are institutions without external sanctioning mechanism that makes people comply with it, or, the other way around, conventions are self-enforcing whereas institutions need not be so. For a more formal definition of conventions Schotter uses the one given by Lewis (1969, p.58) and creates an analogous one himself for institutions:

> "A social convention. A regularity R in the behavior of members of a population P when they are agents in a recurrent situation S is a convention if and only if it is true that, and is common knowledge in P that, in an instance of S among members of P,
>
> 1. everyone conforms to R;
> 2. everyone expects everyone else to conform to R;
> 3. everyone prefers to conform to R on the condition that the others do, since S is a co-ordination problem and uniformly conformity to R is a co-ordination equilibrium in S." (Lewis, 1969, p.58)
>
> "A social institution. A regularity R in the behavior of members of a population P when they are agents in a recurrent situation Γ is an institution if and only if it is true that and is common knowledge in P that
>
> 1. everyone conforms to R;
> 2. everyone expects everyone else to conform to R; and
> 3. either everyone prefers to conform to R on the condition that the others do, if Γ is a co-ordination problem, in which case uniform conformity to R is a co-ordination equilibrium; or
> 4. if anyone ever deviates from R it is known that some or all of the others will also deviate and the pay-offs associated with the recurrent play of Γ using these deviating strategies are worse for all agents than the pay-off associated with R." (Schotter, 1981, p.11)

From 4. it follows that the presence of any kind of sanctioning mechanism is the characteristic that distinguishes institutions from conventions.

Unfortunately, some authors use the term of institutionalized convention, for phenomena such as firms and markets. Two reasons can be given for not doing so. Firstly, by using this term they stress the fact that the

convention has become a separate entity. However, this suggests that the convention itself may interact with agents (*cf.* Ullmann-Margalit, 1977, p.17). In this respect, the methodological individualistic approach of game theory is preferable, because conventions are then interpreted as a result of interactions between agents instead of a separate entity. Secondly, the binding element of a convention norm is conceptually different from the sanction mechanism behind an institution, and therefore the term institutionalized convention is unnecessarily vague. In line with this, another terminological diffusion comes up. Although most authors put firms and markets under the heading of institutions and often do so for good reasons, in the context of this chapter the motive for confirming to the norm is considered important, which is emphasized by using the terminology that was introduced above.

Many authors distinguish between formal and informal institutions and often equate conventions to informal institutions. This distinction may be useful for explaining the replacement of old formal institutions by new ones, as then new formal institutions are often built on remaining old informal institutions, such as habits or conventions (*cf.* Van de Mortel, 1996, p.42). Though the selection of a new institution can be explained by this argument, the reason as to why a convention is formalized is not given. Yet, the distinction between conventions and institutions made in this section aims at such an explanation. Though the rationale behind the distinction between formal and informal institutions does not contradict the distinction between conventions and institutions made above, it distracts the attention from the distinction between the self-enforcing character of conventions as opposed to sanction enforced institutions. Therefore, the terms informal institutions and formal institutions will not be used here. The same holds for an interpretation of conventions as local rules for behaviour and institutions as rules that are standardized at a large scale (Leibenstein, 1984).

To sum up, in the remainder of this book, a norm is said to be a convention if it is self-enforcing and it is said to be an institution if an enforcing authority such as a sanctioning mechanism is needed to support it.

For example, a cartel is considered an institution while the simultaneous annual issuing of new price lists by firms in some sectors is a convention.

4.3 Conventions

Now that the terms convention and institution are defined and their relationship with coordination problems is introduced, a closer look is taken at the mechanism behind the emergence and persistence of conventions. Referring to the scale on which coordination problems can be ordered according to the degree of coordination *versus* conflict, the treatment will be most explicit for pure coordination problems, though most of the text also holds for non-pure coordination problems. The focus is directed on pure coordination problems and conventions that may result, because I consider the self-enforcing character of a convention theoretically more interesting than the external enforcement mechanism within an institution, which is simply decreed. In this section the evolutionary theory in which conventions are explained as solutions to recurrent pure coordination problems is described first. Then, literature that criticizes this theory is discussed. Three assumptions of game theory mentioned earlier, namely instrumental rationality, methodological individualism and state-of nature, not only limit the applicability of the game-theoretic framework presented in the former section, but turn out to be a drawback of the complementary theory introduced in this section as well.

An evolutionary economics approach to conventions focuses on three aspects of their existence, namely the emergence of conventions (variety induction), the selection of a particular convention (variety reduction) and the persistence (replication) of it (*cf.* Dosi and Nelson, 1993 and Vromen, 1995b). As a convention results from an evolutionary process in which one strategy combination is fittest, a two-level nested evolution process can be discerned. However, at times when only one selected strategy combination becomes a convention, these two levels may intermingle so that no evolutionary competition between multiple simultaneously existing

conventions results.

In the emergence of norms strategic interaction and reciprocal expectations play a crucial role, because the pay-offs of actions agents choose depend on the actions taken by other agents. Both features can be analysed within the game format, but the approach is insufficient for pure coordination games. An individual agent alone, however rational, cannot decide on a convention (*cf.* Boyer and Orléan, 1995, p.167). The interaction of agents who form expectations about each other makes simple aggregation impossible. Conventions as the solutions to coordination problems need both a macro and a micro underpinning: the social context influences the individual decision and is influenced by it. Therefore, the process of selecting one out of several coordination equilibria that result from the pure coordination game must be modelled as exogenous to the game itself. The assumption of methodological individualism is too restrictive. Now that game theory does not always give a clue as to which equilibrium to select in a coordination problem, the need for an additional type of decision criterion arises: "coordination requires the common acceptance of some source of suggestion" (Schelling, 1960, p.144). This suggestion should indicate which strategy combination is to be chosen by the players. In 1960 already, Schelling introduced the idea of focal points as a source of suggestion:

> "People can often concert their intentions or expectations with others if each knows the other is trying to do the same. Most situations (...) provide some clue for coordinating behavior, some focal point for each person's expectation of what the other expects him to expect to be expected to do." (Schelling, 1960, p.57)

This source of suggestion can be fairly arbitrary as long as it satisfies the requirement of being shared among the participants of the coordination problem. Three sources of suggestion that are relatively often shared by the participants are discussed in turn, those being contextual features, rules of thumb and past period outcomes.

Firstly, the 'clue for coordinating behaviour' may be given by the

configuration of the problem (*ibid.*, p.69) without any reference to external factors. An often-cited example is the determination of a meeting point by people who cannot communicate about a place to meet. The solutions often chosen in situations like this are characterized by uniqueness or obviousness, *e.g.* the main railway station. As these features cannot be selected by using objective criteria, intersubjectivity is decisive. This implies that the focal point is endogenous, because it is determined by the problem configuration. Following Mehta *et al.* (1994), this kind of salience can be called primary salience, because it follows from the game itself, without any interaction of players. If players have a common background, so that their description of the problem is the same, rationality will make them select the strategy they expect the other player to select. In terms of Mehta *et al.*, this kind of salience is of secondary order, since it follows from one players' conjecture of the other players' perception. In case players also intend to solve a coordination problem, a third type of salience exists, which is called Schelling salience. Schelling salience is a rule of selection which "is salient to the extent that it "suggests itself" or seems obvious or natural to people who are looking for ways of solving coordination problems" (Mehta *et al.*, *op. cit.*, p.661). Although secondary salience and Schelling salience may seem similar at first sight, experiments done by the authors learn that they are not. In other words, the fact that agents have to solve a coordination problem makes them search for rules of selection rather than saliency of one particular option (*ibid.*, p.661). Recently, attempts have been made to rationalize focal points by analysing the way players describe the coordination problem and the alternative strategies they can select (Bacharach, 1993; Janssen, 1995; and Sugden, 1995). For instance, Bacharach models a game in which players have to select wooden play blocks which differ in colour, form, and the grain of the wood. They are given a prize in case they are able to coordinate on the same block. The two steps involved have been modelled by Janssen as the 'Principle of Insufficient Reason,' which eliminates strategies that lack saliency, and the 'Principle of Individual Team Member Rationality,' that has players perceive themselves as a member of the 'team' of players so that it is

rational for them to do their part in a strategy that is selected by the first principle. However, as Janssen seems to admit himself, this theory (especially the first principle) hinges on the assumption of a common background of the players that enables them to represent the strategy options in the same way (1995, p.19). In addition to this, I would say that if this common background is lacking, then the principle does not work, whereas if there is a common background, it may be redundant.

Whereas focal points are endogenously determined by the problem configuration, rules of thumb are determined outside the problem and history is separated from the problem in the time dimension. In this respect, the first source of suggestion differs from the other two.

Secondly, rules of thumb serve as a focal point if they are shared by a group of agents. They are useful in situations with too much or too little information to go through an optimization procedure, in situations of time constraints and in situations in which only little or infrequent communication is possible. One can think of oligopolists who use a common mark-up pricing rule, a rule to determine their advertisement budgets as a percentage of gross revenue, or the same indicators to determine when to change prices. Shared rules of thumb give information on the predictability of competitor's behaviour and may thus contribute to orderly markets.

Thirdly, focal points can be given by common habits, such as issuing new prices once a year, and retailer's discounts in January.[14] Habits emerge if for several periods of time the past choices determine the actual ones, so that history determines the choices made today. Habits as well as adaptive behaviour may be instrumentally rational coordination mechanisms even though they do not always result in the maximum pay-off. For instance, in the example of a non-pure coordination game given earlier, habit may

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[14] A nice example is found in the American automobile industry. In the early nineteen-thirties the seasonal fluctuations in employment used to be large because of the introduction of new models and the spring burst of demand associated with good weather being at the same time. Changing the timing of the yearly automobile show provided a solution, as production of the new models could now take place earlier in the season (Cooper and Haltiwanger, 1993).

indicate the strategy combination 'bottom, right,' which results in higher pay-offs then two other strategy combinations do. If past period choices may (partly) determine the actual ones, path dependence results, which will be discussed more extensively in the next section. Another way in which past period outcomes determine the equilibrium selection in a coordination problem, is by norm messages (Schotter, 1981, pp.128, 134-139). Conventions[15] are then created as a result of updates of information sets, so that players know what choices have been made on previous occasions. Then, present players need only know the choice which is prescribed by the convention. This situation has the advantage that only a limited amount of information is needed for deciding on an equilibrium (*ibid.*, p.139), but it can easily lead to inflexibility and hysteresis. However, in times of uncertainty, following a convention may be the best thing one can do "as long as we can rely on the maintenance of the convention" (Keynes, 1936, p.152). This latter condition indicates the interdependence of collective solutions on individual behaviour and *vice versa* which is common to coordination problems.

The three sources of suggestion may be less arbitrary then they seem at first sight. Using rules of thumb and past period outcomes may be compatible with utility maximizing behaviour, as the marginal costs of other selection mechanisms may be higher than the increase in pay-offs that is to be gained by them. Particularly for informal rules and understandings, precedent is important for providing continuity in the rules of behaviour (Hicks, 1969, p.11). If more than one source of suggestion is prominent, then an evolutionary selection process may take place until one of them becomes the normative one.

Now that the variety inducing phase is described, more is said about the variety reducing and replication stages. If a coordination problem emerges, agents will try to solve it in order to reach a higher pay-off.[16] Then,

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[15] Schotter uses the term 'social institutions' instead.

[16] Utility is assumed to be increasing with pay-off.

supposed that the agents somehow succeed in coordinating their strategies, if the problem occurs again, they tend to use the same solution in order to avoid the unnecessary costs of again solving the problem. As will be discussed more extensively later, though giving a rationale for selecting the same solution is very difficult (Gilbert, 1990), at least there is no reason for deviating once the players have chosen it (Leibenstein, 1984, p.79). The repetition of the problem creates a tacit agreement on the choice of a particular solution. Conventions emerge as "accepted and established solutions to past recurrent problems which - with time - assume the status of norms" (Ullmann-Margalit, 1977, p.76). A crucial point in the mechanism is the transmission of the knowledge of the earlier chosen solution to agents who were not involved in past occurrences of the problem, especially if the earlier chosen solution is not 'obvious' in some way or another. For these 'new' agents, the convention obtains its normative character if they start expecting that others expect them to behave according to the convention. This expectation formation may start from observing the way others behave, or by way of a convention having become habitual or part of culture. Knowing these expectations, a 'new' agent tends to conform to the convention, because it enables him to enjoy a larger pay-off as compared to not conforming as by conforming the agent finds himself in a coordination equilibrium. So, given the expectations of others, the new agents find it in their own interest to follow the norm. The convention that thus comes into existence is self-enforcing, because in a convention the agent prefers himself to conform if others do so as well above the situation in which he is the only one who does not conform. In this way the repeated behaviour becomes binding.

With reference to the nested evolutionary process mentioned earlier, not only strategies are subject to an evolutionary process, but conventions themselves are as well. A convention will persist if it can easily and unambiguously be applied to situations that are analogous to the situation from which it emerged (Sugden, 1986, p.51). In game theoretic terms,

conforming to a convention can be a so-called evolutionary stable strategy:[17] a strategy that is a best reply to itself and to other strategies.[18] Put formally:

> Strategy I is an evolutionary stable strategy when the following two conditions hold:
>
> 1. $\forall J \neq I$: $E(I,I) \geq E(J,I)$ (I is a best reply to itself) and
> 2. $\forall J \neq I$: $E(I,I) > E(J,I) \vee E(I,J) > E(J,J)$ (I is an uninvadable strategy),
>
> or, equivalently,
>
> 1. $\forall J \neq I$: $E(I,I) \geq E(J,I)$ and
> 2. $\forall J \neq I$: $E(I,I) = E(J,I) \Rightarrow E(I,J) > E(J,J)$
>
> with I being the strategy commonly used in a group of agents, J being a mutant strategy, and $E(I,J)$ being the expected utility of using strategy I when the other player uses strategy J (Sugden, 1986 and Weibull, 1995).

In this way, the strategy that is evolutionary stable becomes a convention and the domain of a convention, being the range of coordination problems for which it serves as a solution, becomes smaller or larger depending on the relative fitness of the convention as compared to other conventions.

Since the binding aspect of a convention is endogenous, two aspects of the replication stage, being the transformation of repeated behaviour into a binding pattern of behaviour, deserve further elaboration. Firstly, why does a convention become binding? Secondly, how does it become binding? A convention becomes binding, because it enables agents who find themselves in a coordination problem to secure the attainment of a coordination equilibrium at lowest information cost. It informs agents who face the

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[17] The term was introduced by biologist Maynard Smith: "An evolutionary stable strategy is a strategy such that, if all members of a population adopt it, then no mutant strategy could invade the population under the influence of natural selection." (Maynard Smith, 1982, p.10). More on evolutionary game theory can be found in Van Damme (1994) and Weibull (1995).

[18] An evolutionary stable strategy can be interpreted as a dynamic counterpart of the Nash equilibrium (Furth, 1993, p.362). However, only strict Nash equilibria are evolutionary stable (Sugden, 1989, p.91; Samuelson, 1993, p.215; Osborne and Rubinstein, 1994, p.50).

coordination problem for their first time on how to solve it. A convention also gives a clear algorithm about how to deal with a specified type of problems, so that future occurrences of alike problems do not lead to ambiguities on how to behave. Further, it helps to make the connection between a particular problem and a particular solution more explicit to all members of society. In this respect, a convention can be seen as a public good, because it satisfies the criteria of non-rivalry and non-excludability. It is not subject to rivalry, because it does not diminish by being used by more agents, and it is non-excludable, because agents cannot prohibit each other's being in conformity with it. Conventions can also be seen as assets that are given over from each generation to the next,[19] because they save the costs of information collection and processing and the effort of collectively making a decision as they prescribe equilibrium selection behaviour in coordination problems. To make this more concrete, imagine a market place at which stands can be hired for the yearly fair. Every year there will be new marketeers and more experienced ones. The latter know of conventions, for instance on when to start discounting. They can tell this to their new colleagues, so that a yearly discussion in order to collectively decide on this is prevented. The new marketeers will outlive the elderly ones and instruct the new younger generation. Even if at some time the original problem behind the convention is not known any longer, the convention remains to serve as a solution to it (Schotter, 1981, p.14).

The fact that some solution is the generally accepted one, slightly changes the pay-off structure of the problem to the advantage of the chosen solution (Ullmann-Margalit, 1977, pp.85-87). Strictly speaking, in this way, a pure coordination problem ceases to exist once a convention is established, for the requirement of there being at least two equal pay-off equilibria is no longer satisfied, since one of them has become more attractive by its being chosen before. Put differently, a pure coordination game can only be

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[19]However, inserting conventions in an Overlapping Generations Model as a second asset besides a monetary store of value has not proven a fruitful approach yet.

repeated up till the establishment of a convention, although this is a gradual process. From then on, it has become a different game.

The question as to how a norm becomes binding has a twofold answer. Firstly, communication of the norm increases the probability of everyone conforming to the convention and so attaining a high pay-off outcome (Sugden, 1986, p.41). Rational agents who repeatedly chose a particular strategy to solve the coordination problem will therefore contribute to the diffusion of a norm by communicating it to others, as long as the costs of communication are lower than the marginal pay-off that is gained by coordination. Secondly, motives that are not necessarily linked to pay-off may support the process of a norm becoming binding. Sugden (1989, p.95) considers the human desire for the approval of others as crucial to the transformation of a regular pattern of behaviour in a binding norm. The desire for approval forms the basis of social pressure to conform, which emerges as people expect each other to conform to the norm. Though the desire for approval can be rationalized in terms of survival of the individual, they are less rational with regard to the coordination problem only. Related arguments are reputation, the feeling of belonging to a group, the need to maintain self-esteem or the avoidance of guilt-feelings, which also underpin a pressure to conform (Boyer and Orléan, 1992, p.166; David, 1994, p.211). These non-pecuniary motives are supplementary to the above explanation of norms in terms of solutions to coordination problems, but not necessary for the underpinning of their existence. They merely contribute to the change of the pay-off structure once a convention has come into existence. In other words, conventions are voluntary complied with, but the pressure to conform may strengthen the conventional norm for behaviour. To sum up, both for the emergence and the persistence of conventions, the role of expectations that agents form about other agents' behaviour and their expectations is of crucial importance. As a matter of fact, the opposite holds for institutions, as the social pressure to conform and accompanying expectations support the institution, but are not of crucial importance like sanctions are.

If the source of suggestion creates an asymmetry between players, a convention can develop even easier, as is described by Sugden (1986). The development of a convention by asymmetry can be summarized as follows. A game is played by two players. If a player considers his opponent as different from himself and if he considers this difference as crucial to the pay-offs to both players, the game is called asymmetric. Therefore, in an asymmetric game a player will first determine which of the two possible roles he is to play, before deciding on his behaviour. If both players recognize the asymmetry and if they behave accordingly, a convention can develop. The crux of this evolutionary process is the mutual recognition of the characteristics of the players that determine the asymmetry. In other words, the players somehow must manage to agree beforehand on who is to play what role. The characteristics that are crucial are often not rationally determined, but seem to be a matter of prominence: features that seem unique, prevalent, or easy to recognize in other situations. In this respect, the explanation resembles the idea of focal points expressed above. The easier a player can conjecture which aspect the other player considers decisive on the division of roles, the easier a convention emerges on how to play a particular game. It is the recognition of asymmetry that prevents players from a situation of infinite regress, because the strategy bringing the highest pay-off to the players is now contingent on their role instead of the action of the other player. Communication supports and accelerates the evolution of conventions, because information diffuses more quickly among players, but it is not necessary for the process as such. During the process of broader acceptance of a convention in society, the asymmetry becomes larger, thereby accelerating the acceptance: the development of conventions is a self-reinforcing process. Sometimes more conventions compete for a period of time, until the one that is most widely used, becomes the standard. For the evolution of conventions to be possible, games are assumed to be played repeatedly by anonymous players who are able to learn from past behaviour. Anonymity is a condition that prohibits reputation building and forces the players to act according to their role instead of their knowledge of their

opponent.

Up till now, the discussion has been on the emergence of conventions in a situation without any conventions, following the state-of-nature approach. Apart from the problems this approach invokes, which are discussed below, some consideration to the emergence of new conventions in situations in which conventions already exist is relevant for applying the theory of conventions to economics. The fact that conventions are rather stable over time can well go together with shifts in conventions during long periods of time. In case of a large shock, the context of a coordination problem may change drastically, thereby changing agents' behaviour and their expectations concerning other agents' behaviour, so that a new way of coping with the problem emerges. A convention shift which results from an external shock is easier to explain than an endogenous convention shift, because of the self-enforcing character of conventions. Competing conventions are studied in evolutionary game theory by modelling players who are spatially located and interact with their neighbours (*e.g.* Boyer and Orléan, 1992). Every interaction is a game in which a convention 'wins', after which the domain of the winning convention expands. The utility of following a convention increases with the number of agents who do so as well, so that a successful new convention can enforce itself (*ibid.*, p.166). Competing conventions resemble classifiers to the extent that they prescribe behaviour in certain situations and that the power of successful classifiers increases, so that the norm for behaviour becomes more generally adhered to (*cf.* Sargent, 1995, pp.77-81). However, this leaves the question as to how a competing convention can come into existence unresolved. If a convention has become established and no shock occurs, it is hard to model the emergence of a new convention. One has to allow for changes in the properties of the game: learning changes the type of agents, the rules of the game or the strategies open to players may change, changes may occur in the pay-off structure, or new players enter the game. Changes like these are easier visualized in economies than in game theoretic models, because in

game theory the game changes into a different one. For instance, an increased flexibility in employment contracts changes people's attitude towards other long-term commitments as well, such as education or mortgages. The migration of people across cultures brings different business practices, with more or less formal styles of transacting and commitment. As for game theory, changes like these can be interpreted as emerging in the "ultra long run" in which a game settles into a new equilibrium (Binmore and Samuelson, 1994).

Now that the evolutionary explanation of conventions is given, some critical remarks given by several authors will be discussed. The game theoretic assumption of methodological individualism has already been criticized. At this place, the assumptions of instrumental rationality and a state-of nature economy will be scrutinized.

Firstly, the question as to whether or not instrumentally rational individuals will conform to a convention is discussed. In the above text, for the sake of the argument the affirmative answer was given, but at the cost of oversimplification. Therefore, a more thorough discussion of the literature on this matter is warranted. The reader may note that the following discussion on the rationality of conforming to a convention is distinguished from the discussion earlier in this chapter on the rationality of coordinating on a (focal point) strategy (Goyal and Janssen, 1996).

For a repeated coordination problem, Lewis (1969, pp.35-36) is one of the first to argue that the formerly chosen solution may be the salient one in a next instance of the coordination problem. He derives his argument from the experiments done by Schelling (1960), in which the configuration of a coordination problem turned out to be the cause of saliency. Lewis is not entirely clear on how choosing the salient solution relates to rationality, nor on why the past period outcome is the unique rational solution. Authors following Lewis often implicitly assume that conforming to precedent is rational. This aspect is scrutinized by Gilbert (1990), who does not consider this assumption valid:

> "... common knowledge of precedent as such will not by itself automatically generate expectation of conformity or conformity on the part of rational agents" (p.10) and:
>
> "... the claim that the precedented case will be salient appears to depend on psychological assumptions that may not be true of rational agents as such" (p.11).

Rationality only implies following a convention if an agent knows that the other player will do likewise. As long as this knowledge is lacking, which is the essence of a coordination problem, rationality does not rule out other behaviour than the conventional one. This leads to the conclusion that conformity to a convention does not follow from rationality alone. If agents still succeed in coordinating their actions by way of a convention, "their success depends on a residual element of non-rational action" (Sugden, 1991, p.776). Rationality can explain the selection of Nash equilibrium strategies, but the selection of one out of several Nash equilibria needs additional behavioural assumptions (Rabin, 1994, p.85). As long as these behavioural assumptions boil down to a form of (pre-play) communication and result in binding agreements, they are more suitable for cooperative games than for coordination games, so that conventions still cannot be derived from the game itself. Gilbert tries to remain within the framework of individual rationality by suggesting a 'Personal Principle Model.' In this model, a player can decide to follow a 'personal principle' of adopting the strategy rule of sticking to a convention strategy as long as it solves the coordination problem successfully. It is then argued that maintaining the principle can follow from rationality, but the principle itself is arbitrary (Gilbert, 1990, p.13). Still, it leaves the selection of the 'personal principle' unexplained. Further, as Gilbert herself admits, giving up the principle can be consistent with rationality, so that no positive argument for keeping it is given (*ibid.*, pp.14-15).

Other less formal arguments that underpin the insufficiency of the rationality argument for underpinning compliance to conventions are given by Leibenstein (1984, p.80). Though in game theory all players are assumed

to know the pay-off structure of the game, in reality individual agents may not know that everyone gains by adhering to a convention. Besides, if a convention holds for many situations, it may be profitable to be a free-rider in some of them. As these two arguments are presented in a framework[20] that differs from the one in which coordination problems are discussed here, they are only mentioned and not elaborated upon.

Leaving the concept of individual rationality by substituting other concepts for it, is the essence of two approaches taken in order to underpin the existence of conventions. The first one is taken by Sugden (1991), who suggests to start from the notion of group rationality. The group of players in a coordination game can be seen as a team that collectively decides on a particular equilibrium strategy instead of each individual team member doing so (Sugden, 1991, p.777). If a team does so, all players are better off by following the team strategy than by deviating from it, as long as they know that the other players will conform as well. Players who act on the team rule are then called cooperators (*ibid.*, p.778). In my view, this indicates the essence of the approach: a coordination game is replaced by a cooperative game. The convention is replaced by an institution like: "follow the team rule or thou shalt be thrown out". Therefore, this approach does not contribute to an explanation of a convention as repeated voluntary coordinating behaviour by individual agents in a (pure) coordination problem.

The second approach is based on institutional individualism, which allows for the assumption of some coordination in order to explain the existence of other coordination, thereby alleviating the infinite regress problem one faces while starting from scratch (Hodgson, 1993, pp.9-10). Coordination behaviour can be explained by substituting the concept of institutional individualism for a purely individualistic approach (Agassi, 1975). For instance, the framework of institutional individualism can underpin the common background assumption discussed earlier (Goyal and

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[20]Leibenstein's terminology, with conventions as local and institutions as general rules for behaviour, allows for (what he calls) conventions that are enforced by sanctions for the reasons repeated here.

Janssen, 1996). Still, the determination of the initial conventions remains arbitrary as this choice cannot be based on fundamentals. The economic approach which aims at an *ex post* rationalization of conventions is incomplete if not supplemented by a historical analysis (Vromen, 1995a, p.5). Therefore, in order to explain existing conventions, a historical approach is warranted. Such approach can reveal the consistent patterns of expectations which evolved over time as facilitators of coordination (David, 1994).

The third assumption underlying the game theoretic approach to coordination problems is the assumption of a state-of-nature economy. The game format can be used to compare an economy in a 'natural state' with an economy in which some specified conventions or institutions exist, but the development towards these norms cannot be modelled in one game, as then the pay-off pattern changes. That is, strategies that yield highest pay-off in an economy without norms may not do so in an economy with conventions and institutions (Schotter, 1981, pp.150-153). This limitation of the game theoretic approach is too restrictive for the analysis of conventions, because they often evolve from the specific contextual characteristics of a particular coordination problem (Vromen, 1995a, pp.3,17). The institutional individualistic approach may be more fruitful, both because it is able to incorporate dynamic processes and because it gives a more plausible description of reality (*ibid.*, pp.4,14).

Up till now three assumptions of game theory were scrutinized, namely methodological individualism, instrumental rationality and a state-of-nature economy. Institutional individualism was found to be more adequate for analysing coordination norms. In the next section the fourth assumption of game theory, being the assumption that agents have all the relevant information, is released. The Institutional Economics point of view focuses on transaction and information costs. This approach also differs from the game-theoretic state-of-nature approach in that it first takes institutions, which is also to include conventions, as given and then tries to rationalize their existence. In this sense it may be seen as an application of the institutional individualistic approach to coordination problems (Agassi,

1975, p.152).

4.4 Institutions and Information: Some Notions from Institutional Economics

Though institutions are the focus of analysis of all three branches of Institutional Economics, 'Old', 'Neo', and 'New' Institutional Economics take a different approach. As of yet, no agreement exists on the precise distinctions between the three (see *e.g.* Eggertson, 1990; Groenewegen *et al.*, 1995; Hodgson, 1994; and Mäki, 1993). In particular, authors categorize 'Neo' and 'New' according to different criteria, or seemingly reverse both terms. By way of introduction, some differences will only be sketched out here. 'Old' Institutional Economics explicitly takes into account the feedback relation of the institutional context on an individual agent and can be fairly easily combined with evolutionary economics (Hodgson, 1993). By not satisfying the criterion of methodological individualism, 'Old' Institutional Economics may be relatively close to the institutional individualism approach. 'Neo' Institutional Economics differs from 'Old' Institutional Economics in several respects: it considers individuals as instrumentally rational with exogenous preferences, it satisfies methodological individualism, and it develops new concepts of markets and firms. Of all three branches, it is most closely related to standard microeconomics, with the introduction of transaction and information costs as an amendment. At the other hand, 'New' Institutional Economics rejects the assumption of rational choice, thereby being closer to 'Old' than to 'Neo' Institutional Economics (Eggertson, 1990, p.6). Since in this section an eclectic approach is taken, the theory will be referred to as Institutional Economics. The focus of the discussion will be on information, because lack of information causes coordination problems.

In the Institutional Economics approach the term institutions has a different connotation as compared to the above text. In the former sections, institutions were norms with an external sanction mechanism that made the

norm a binding one. Besides, conventions were norms without the need for such a mechanism, as they were self-enforcing. Institutional Economists choose a broader interpretation that covers both conventions and institutions in the sense of norms, so these terms are now treated as synonymous. A definition by North follows soon below. The broader connotation of the term institutions implies that some arguments presented in section three above also apply to institutions as described here, such as the discussion on institutional individualism.

From the Coase theorem it can be inferred that institutions do not matter as long as transaction costs are zero, because the institutional setting can then be changed at zero costs.[21] According to North, two sorts of transaction costs exist, namely measurement cost and enforcement cost. This implies that institutions matter: the initial institutional setting, at least partially, determines the outcomes of behaviour. Institutions can then be defined as "the humanly devised constraints that structure human interaction" (North, 1994, p.360). They consist of formal rules, informal norms,[22] and enforcement characteristics which together act as constraints on the human behaviour. An institution may thus become manifest "in a long-standing historically determined set of stable, abstract and impersonal rules, crystallized in traditions, customs, or laws, so as to implement and enforce patterns of behavior governing the relationship between separate social constituencies" (Ménard, 1995, p.167). It may now be clear that both types of norms that were used distinctly in the above text satisfy this definition of institutions, so that the discussion may safely be continued by only referring to institutions in the sense of North' definition. This is not surprising, given Ullmann-Margalit's definition of coordination norms that was used there, in which norms were interpreted as rules for behaviour. The approach is a

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[21] Some authors see property rights as an institution. For the Coase theorem to hold, property rights must be well-defined.

[22] For a discussion on formal *versus* informal institutions, the reader is referred to section 4.2.

methodological individualistic one as far as it focuses on the individual instrumentally rational agent who maximizes his utility while being constrained by his context in which institutions may exist. However, as North admits, not all existing institutions can be explained by the transaction costs approach (North, 1990, p.7). In other words, some institutions are not the most efficient solution to the problem they were intended to solve or the need they were intended to satisfy (Sjöstrand, 1992, p.1031; Vromen, 1995a, pp.10-11).[23] As Bicchieri criticises in her discussion of rational choice theory and social norms as *explanans* of human action: "Attempts at bridging the gap have tried to establish either that social norms are rational, in the sense of being efficient means to achieve individual or social welfare, or that it is rational to conform to norms, thus reducing compliance to utility maximization." (Bicchieri, 1993, p.227).

This limitation of the instrumental rationality approach calls for an extension of theory, which can go (at least) two ways. The first approach is an evolutionary one: individuals need not be instrumentally rational, but the instrumentally rational behaviour is the attitude that is fittest in the evolutionary struggle for survival, in this case being economic competition (North, 1990, p.19). However, even if this is so, the existence of less efficient institutions in the long run cannot be explained. The second approach aims at a different concept of rationality. "Procedural rationality is the way that the institutional and informational contribution, which cannot itself be reduced to instrumental rationality, is introduced into the explanation at the level of the individual" (Hargreaves Heap, 1989, p.71). This concept "portrays the individual as a rule follower, a person who follows norms, recipes or procedures for action" (*ibid.*, p.4). It closely resembles Rowe's concept of rule individualism. Rowe (1989, p.4) distinguishes act-individualism from rule-individualism. In cases of act-individualism the isolated action is the unit of rationality, whereas in cases of rule-

[23] With reference to the model of a non-pure coordination problem, this phenomenon can be visualized as $y > x$ and agents coordinating on 'bottom, right'.

individualism the rules of action are rational. "A rule of action is rational if, by following that rule, an agent maximizes his expected utility" (Rowe, 1989, pp.4-5). In this sense a game strategy can be seen as a rule of action. Further, Rowe defines society as agents following rules (*ibid.*, p.6) and states that "what we call social institutions are in fact nothing more than agents rationally following rules of action, and being believed by other agents to do so" (*ibid.*, p.5). The transformation of a rule into a convention takes two steps:

> "... a rule is likely to acquire moral force if it satisfies two conditions:
>
> 1. Everyone (or almost everyone) in the relevant community follows the rule.
>
> 2. If any individual follows the rule, it is in his interest that his opponents - that is, the people with whom he deals - follow it too.
>
> Any rule that is a convention necessarily satisfies a third condition:
>
> 3. Provided that his opponents follow the rule, it is in each individuals interest to follow it." (Sugden, 1986, p.166).

This description bears close linkage to the definition of a convention given by Lewis and Schotter that is cited above. Step two begs the question insofar as it leaves unexplained why the player's opponents should follow the rule. The answer that easiest comes to mind is that all agents are assumed to have the same interest, so that step 2 holds for them as well, but this answer is analytically not satisfactory. Rule individualism and procedural rationality both consider the rationality of a pattern of action instead of the actions themselves. This can be considered an extension of rationality as opposed to the concept of bounded rationality, which is a limited sort of rationality (Hargreaves Heap, 1989, p.119). The result will, if not maximal, be satisfactory at least, so that the outcome with an institutionalized rule of behaviour is better than without one (Schotter, 1981, pp.148-149). This view is shared by Bicchieri, as she interprets norms as "a function of individual choices and, ultimately, of individual preferences and beliefs" (1993, p.229),

which may be interpreted as taking a methodological individualistic stance.[24] Procedural rationality contributes to a macro foundation of microeconomics to the extent that procedures are common among agents. In this view, procedural rationality is not an extension of instrumental rationality, but a reversal of it, as instrumental rationality underpins a micro foundation for macroeconomics (Hargreaves Heap, 1989, p.146). Procedural rationality mitigates lack of information, because it makes actions by individual agents more predictable. This effect is even stronger if procedures are institutionalized, so that the mere existence of the institution aids in forming expectations on agents' actions. In this sense, shared mental models can be considered institutions (Denzau and North, 1994). The cost of this predictability is limited individual freedom, which is in line with the North definition of institutions as humanly devised constraints on behaviour.[25] All this only holds in a society with incomplete information, since otherwise, by definition, no need for extra information can exist: in a world with perfect information, coordination norms are redundant. Incomplete information forces agents to act on predictions in case information is lacking, and extra information that makes predictions better enhances efficiency. Like the classifier systems that were mentioned earlier, institutions can be seen as an "information mechanism" which connects messages to outcomes (Ménard, 1995, p.166). The messages can be interpreted as the interdependent decisions which need to be made, while the outcomes can be seen as predictable behaviour, but the other way around also holds because of the self-reinforcing character of norms of behaviour. As prices are information carriers as well (*cf.* Alchian, 1977), institutions can be seen as complementary to prices: "Social and economic institutions are informational devices that supplement the informational content of economic systems when

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[24] A discussion on methodological individualism and the micro-macro debate is given in Janssen (1993).

[25] The reader may note that what is called 'the institutionalization of procedures' in this section, is essentially the same as 'repeated patterns of behaviour becoming a binding norm with a sanction mechanism' in former sections.

competitive prices do not carry sufficient information to totally decentralize and coordinate economic activities" (Schotter, 1981, p.109). This complementarity can be put on a scale, with perfect competition at one side and monopoly on the other. In a perfectly competitive economy, prices contain all relevant information; in an oligopoly situation prices are complemented by conventions; and in a monopoly conventions supply information as prices do not reflect production cost information (Schotter, 1981, p.158). Whereas prices can be seen as complementary to institutions, markets are often interpreted as institutions. Several ways in which market transactions are institutionalized then go together with the informational role of prices, like Schotter argues. The other way of institutionalizing transactions, by a hierarchical organization, goes together with internal prices that perform a function partly different from market prices (*cf.* Ménard, 1995).

In the above discussion of institutions and information, the point was made that institutions enhance the predictability of action and thereby contribute to information in society. More can be said about this relationship if the influence of incomplete information or fundamental uncertainty on the existence of institutions is considered. To give an impression, two possible underpinnings of this relationship are introduced. Both are based on an amendment to the concept of (instrumentally or procedurally) rationality insofar as now allowance is made for limitations on the cognitive capacity of agents, which more closely resembles reality. Firstly, in situations of fundamental uncertainty agents are not able to optimize over the whole range of possible actions. Their individual limited cognitive capacity forces them to restrict the amount of information they absorb and to simplify their behaviour. Predictable behaviour then follows from uncertainty that prevents agents to maximize (Heiner, 1983, p.561). This predictable behaviour may influence the expectations agents form about each other's behaviour and expectations, so that it may be worthwhile to continue behaving in a predictable way, which makes the behaviour binding so that it satisfies the definition North gives of institutions. Secondly, in situations of

uncertainty, beliefs and trust become at least as important as knowledge. Institutions then can become carriers of these beliefs and are able to persist because they are believed to do so.

Another relationship between institutions and information runs as follows. In a context of incomplete information, transaction costs in the form of information costs exist. These transaction costs reflect market imperfections, and result in increasing returns to scale for institutions, so that larger institutions require less information per 'participating agent' than do smaller institutions. This may result in the existence of only a few large institutions that disperse more information in terms of predictable behaviour. Institutions that are established tend to persist because of this scale effect. In terms of procedural rationality this argument can be put as follows: if many incompletely informed agents conform their behaviour to a common procedure, it is rational to join them (*cf.* North 1990, p.108). This argument resembles the line of thought expressed in the treatment of pure coordination problems above.

Here, the notion of path dependence comes in: the existence of institutions not only depends on their efficiency or utility increasing effects, but on their existence in former times as well. In order for this statement to make sense, time should be seen as historical instead of logical: events are dependent on the moment in which they happen (O'Driscoll and Rizzo, 1985). If initial conditions are absent, explaining institutions from path dependence leads to indeterminacy (Knudsen, 1993). With the presence of initial conditions, an infinite regress problem may emerge, because at every stage in the development of an institution, the preceding stage is a necessary element of an underpinning of its existence. As was noted before, the institutional individualistic approach allows the theorist to take some initial conditions as given.

In an economy with incomplete information, learning may improve the agents' ability to coordinate. The concepts of historical time and path dependence are linked with learning, because learning is irreversible (one cannot wipe out human routines and memory) and because the knowledge

that results from past learning determines the present learning process. The latter statement refers to the concept of framing that is taken from theories on cognition (Denzau and North, 1994). Reflexivity, a term taken from sociology, captures the incorporation of agents' theories of other agents into their own actions (Farmer, 1995, p.71). Here, learning is described as the interpretation of information within an agent's framework, which serves as his model of the world, as well as redesigning the framework itself if new information requires so (representational redescription). A parallel can be drawn between the evolution processes of mental frameworks at one side, and conventions and institutions at the other, insofar as all three tend to persist once they emerge, but they are replaced by new ones once their context changes drastically. This characteristic could be captured by the term locally robust. A drastic change of context refers to, respectively, different (sorts of) information, and new problems, new types of behaviour or a new focal point. The idea of norms being locally robust resembles the 'corridor' designed by Leijonhufvud. Within this 'corridor' around a full-coordination time-path, deviations do not challenge the stability of the path, whereas disturbances that bring the economy outside the 'corridor' lead to a fundamental different state of the economy, with Keynesian characteristics (Leijonhufvud, 1981, pp.109-110). In the same fashion a coordination norm may change once the coordination problem or its context has changed significantly (*cf.* Binmore and Samuelson, 1994). This notion is comparable to Leibenstein's inert areas: "a set of bounds, say upper and lower bounds, within which any decision maker will not change his decision" (Leibenstein, 1984, p.79). Learning can also be a source of change for institutions if agents learn of a substantially more efficient institution to perform a task. The same holds for a convention shift: the replacement of one convention by another. Shared mental models form a culture or an ideology and this may contribute to the explanation of different institutional configurations in different countries, for instance Islamic banking without interest *versus* Western

banking with interest.[26]

Institutional Economics provides many building blocks for an interpretation of institutions. It brings in the necessary extra's that game theory misses because of its rigorous assumptions of instrumental rationality, methodological individualism, a state-of-nature economy and information availability. At the other hand, these very assumptions make game theory attractive, because it can be used without having to make arbitrary assumptions about the agents and their initial institutional context in which they face coordination problems. In this way, both theories complement each other.

[26] For other illustrations and more on cultural institutional diversity see North (1991) and Denzau and North (1994).

5 Trust in a Monetary Economy

5.1 Focal points, common background and trust

In the former chapter, conventions and institutions were interpreted as norms for behaviour which facilitate coordination. In a monetary economy, many situations occur in which outcomes of decisions are interdependent, so that coordination problems arise. Since many of the existing conventions and institutions may not result from conscious design, a functionalist approach which aims at an *ex post* rationalisation has its limitations, because a rational reconstruction may be inappropriate for understanding the factual evolution of norms (*cf.* Vromen, 1995a, p.5). The same was argued for rather similar 'invisible-hand explanations' by Ullmann-Margalit (1978). Besides its lack of a historical account of the evolution of norms, the functionalist approach cannot provide an explanation as to their origin. The latter lacuna is most relevant to conventions, because of the equivalence of coordination strategies in terms of pay-off outcomes (see section 4.3). The economic framework and its choice theoretic foundation have to be supplied with notions from history and sociology in order to arrive at an account of the institutional structure of economies. In this chapter, the issue of trust is singled out, because it provides an alternative guide to action in situations were information is limited or costly, so that it complements explanations of norms from economics such as discussed in chapter 4. However, the focus on the role of trust does not imply a neglect of other factors, that is, the analysis is subject to a *ceteris paribus* clause. Moreover, the analysis is limited in that it studies trust only insofar as it contributes to solving coordination problems. The impact of trust on the economy may be far larger, as the following quote suggests:

> "The advantage to mankind of being able to trust one another, penetrates into every crevice and cranny of human life: the economical is perhaps the smallest part of it, yet even this is incalculable." (Mill,

1869, p.68)

To sum up, the discussion of trust is limited to its impact on coordination problems and it is partial in that the role of trust is singled out from other factors which also affect the performance of economies.

In the former chapter, a game theoretic approach to coordination problems was taken. Often, people do better than game theory predicts, because they succeed in coordinating their strategies. For instance, they coordinate on a medium of exchange which is commonly accepted. Several approaches to the problem of rationalizing the existing forms of coordination have been taken. Most of them aim at refining the description of the agents and their rationality, for instance by introducing learning behaviour, or by refining the (subjective) representation of the coordination problem. Focal points can be part of this subjective representation (Schelling, 1960; Mehta *et al.*, 1994). From a rationalization-oriented point of view, focal points are arbitrary because they do not fit in a state-of-nature approach. Contributions to rationalizing conventions or focal points are made by *e.g.* Goyal and Janssen (1996) and Bacharach (1993). However, these rationalizations cannot start from scratch. The Principle of Insufficient Reason shows that some common background is needed in order to ensure that agents perceive the coordination problem in the same way. The principle provides agents with arguments for selecting an option by ruling out choices between options which are identical in the framework of the agent's perception (Bacharach, 1993; Janssen, 1993; Sugden, 1995). A difference can be made between approaches which allow agents to choose their framework of perception and approaches which consider the framework as being given (Sugden, 1995). The references just mentioned yield insights in the opportunities and limitations of rationalizing focal points. They reveal that focal points can be rationalized, that is, selecting the salient strategy option is found compatible with (instrumentally) rational behaviour. This is so, because focal points are both conspicuous and unique, so that they can both be perceived as an option and be recognized as a special option (Bacharach, 1993, p.270). Together these characteristics make one strategy option the salient one: a focal point.

However, the Principle of Insufficient Reason begs the question as to how agents come to represent the coordination problem in the same fashion. In game theory the background of players is assumed to be blank, as the game is played in a state-of-nature economy. In order to arrive at a complete rationalization, an explanation of their common background must be given, which requires an analysis of elements beyond the game framework. For instance, an initial convention or institution must be introduced in order to provide the players with a common background (Goyal and Janssen, 1996, p.18). The concept of institutional individualism refers to a related line of thought (Agassi, 1975). So, the gain of rationalizing the selection of a strategy goes at the expense of an assumed common background which cannot be rationalized (*cf.* Janssen, 1995, p.19).

The above option of starting from an initial situation which is not neutral aims at rationalizing conventions and institutions given a minimal degree of arbitrariness. However, not all explanations take the form of rationalization. For instance, explaining norms for behaviour by referring to culture, upbringing, education, or even biological genotypes, are all examples of possible explanations which are not necessarily related to rationality or the choice theoretic paradigm. This chapter argues that in order to explain real world outcomes of coordination problems, taking a closer look at the common background of the players by studying aspects of their common culture could be at least as useful as the approaches referred to above. In particular, the degree of trust people share by their common culture may provide an anchor of expectations, and thus contribute to an outcome characterized by a coordination of strategies in problems of interdependency. This approach does not contradict the approaches just discussed, but emphasizes the impact of the common background of the players instead of focusing on their rationality by which they select a strategy. For instance, from an evolutionary point of view, the selection of a particular strategy combination can be reconciled with historical developments and path dependence. Habits, tradition and cultural norms may provide the missing part in the explanation of conventions and institutions, particularly in their emergence but also in their persistence. The

cultural context of the coordination game may thus provide a focal point, because it influences the individual processes of strategy selection of the players who have this cultural background in common.

For three typical occasions of coordination problems, the argument can be specified. In case of a pure coordination game, the coordinated outcome is not unique in the sense of yielding the highest pay-off. The idea of focal points is most relevant here, since the pay-off structure does not give a clue as to which strategy combination to coordinate upon. At the same time, its role is important in that any coordination is preferred above none. The latter also holds for nonpure coordination problems, in which the pay-off structure singles out one strategy combination as having a unique highest pay-off. Still, any coordination is better than none at all. In this respect, signalling can be more profitable in a nonpure coordination problem than in a pure coordination problem. For instance, in terms of the diagrams of chapter 4, coordination in a pure coordination game yields a gain of '1' per player, whereas in a nonpure coordination game it yields a gain of '1' or '2', depending on which combination of strategies is selected. On the other hand, the importance of achieving coordination relates inversely to the relevance of having a common background, because in a nonpure coordination problem, the pay-off structure itself already provides saliency. Therefore, in a static context, the idea that a common cultural background can make agents trust each other to do their part in a coordinated strategy is most relevant for pure coordination problems. In a dynamic setting, trust can become important even in a nonpure coordination game in order to make agents who used to play 'bottom, right' situation be sure that they switch together to the most profitable 'top, left' combination of strategies. The aspect of trust is an important part of culture, because it relates to signalling of intended actions and commitment to coordination. In the case of conflicting interests, such as in mixed motive games and prisoners' dilemma games, signalling is even more important. The Folk Theorem predicts that a cooperative outcome will be reached once the same pair of agents plays the game repeatedly. In practice, either the combinations of players may differ or communication may be prohibited. For instance, cartel regulation forbids price

agreements, so that firms wanting to cooperate can do so only tacitly. They are able to coordinate on a strategy of 'high prices' only if they can convincingly signal their commitment to the cartel strategy. The trust among the firms is put to a test once information about prices is incomplete, so that a 'low price' can either indicate a breach of the cartel or be the result of different calculations. Both conventions on a public source of information as a basis for price calculations and trust in the commitment of cartel partners are needed in order to sustain the tacit cartel arrangement (*cf.* Hargreaves Heap, 1992, p.123). This line of reasoning also explains why prices change infrequently. Price changes based on private information are suspect, because an implicit reference to the common background of the cartel members can not be made (*ibid.*, p.125). However, price changes based on publicly available information are difficult to hide, so that in both cases changing prices is not likely to occur often. Another way in which trust plays a role in a nonpure conflict game is its saving on the costs of creating a credible threat to retaliate in case the other player defects. These costs, and the possible costs of implementing the threat strategy, can be saved in case the other player is trustworthy. Partners in business may even go as far as to leave the cost-benefit framework of game theory and behaving trustworthy because of their sense of honour or certain ethical principles (*cf.* Sako, 1992, p.46). To these motivations and their impact on the functioning of coordinating institutions the economy, the attention is turned now.

As done earlier, a distinction can be made between types of coordinating norms for behaviour. Conventions are norms which coordinate behaviour in pure or nonpure coordination problems. They are not unique and can be said to be self-enforcing. Institutions are enforced by sanctions, as they solve nonpure conflict problems, such as modelled by prisoners dilemma games. Mixed motive norms govern behaviour in situations with both conflict and coordination elements involved. Focal points are relevant in case of pure coordination problems, so that most of the argument presented here holds for these situations. The relevance of trust, however, goes further than providing support for coordinated behaviour in situations of coordination problems.

Compliance with institutions such as legally binding contracts can be enforced, but never guaranteed. Therefore, unless specified otherwise, the benchmarks of conventions, also called informal institutions, and (formal) institutions will often be discussed together. Then, the term institutions refers to institutions in the broader sense of "the humanly devised contraints that structure human interaction" (North, 1994, p.360).

5.2 "Trust is..."

The consequences of the presence or absence of trust are clear to many, but the concept itself is difficult to define. In this sense, trust resembles love, like the "Love is..." cartoons illustrate, or happiness. Neither trust nor love or happiness can be obtained by bribery or purchase without destroying it (Frankel, 1977, p.37). The agreement to trust cannot be bought, neither does a contract to work together ensure the trust necessary to execute the contract (Arrow, 1974, p.26). Insofar as trust can be considered a variable, it is of an ordinal nature, like utility. However, being able to compare situations of more trust with less trust is not the same as defining the concept. Therefore, most authors on trust approach the concept either by describing the impact of trust or by disentangling the concept in aspects of trust. In this chapter, the impact of trust on the way agents solve coordination problems is emphasized.

Trust is closely related to social norms for behaviour. It can be argued that both phenomena feed back upon each other. For the present context of analysing institutions, the causality from norms to trust is emphasized by arguing that trust follows from predictable behaviour which is structured by norms (see also section 5.3). Norms are often taken for granted until they are violated, just like trust is seldomly taken into consideration unless it is lacking (Zucker, 1986, p.54). Cases in which trust cannot be taken for granted are risky, because unsatisfactory outcomes have a positive probability to result. The relevance of trust lies in reducing perceived risks. If there is no perceived risk, then people have confidence in their expectations of others' behaviour rather than trusting them (Luhmann, 1988, p.97). Contracts aim to reduce risks by

specifying behaviour in contingencies. As contracts are seldomly complete in specifying all contingencies, room is left for risk and for trust to reduce the perceived risk (Rowe, 1989, §5.5). Trust is also relevant in situations of (fundamental) uncertainty, as agents must then act upon their expectations and imagination (Allsopp, 1996). Many definitions of trust relate to situations of risk or uncertainty, for instance:

> "Trust amounts to the expectation that the other party, even if circumstances change, would stick to an agreement" (Khalil, 1994, p.339);
>
> "The key aspect of trust [...] concerns the extent to which an organizational form provides reliable knowledge about future outcomes" (Gill and Butler, 1996, p.81).

In definitions like these, trust is a piece of information concerning the behaviour of others. This informational aspect of trust is relevant to coordination problems. However, if information concerning the behaviour of others reveals that they are not trustworthy, then information may no longer be lacking but the risk remains (Fukuyama, 1995, p.366 note 6). Trust encompasses more than information in that it also indicates which kind of behaviour to expect, namely trustworthy behaviour. In other words, trust is different from information in that an ethical aspect is involved:

> "Trust is the expectation that arises within a community of regular, honest, and cooperative behavior, based on commonly shared norms, on the part of other members of that community." (Fukuyama, 1995, p.26)

This definition of trust indicates that the very source of trust, being commonly shared norms for behaviour, distinguishes trustworthiness from lack of it. The combination of information and shared norms makes the definition by Fukuyama suitable for the present purpose of analysing the role of trust in sustaining institutions. In terms of a coordination problem: if agents share a set of norms for behaviour, they can trust each other to do their part in a coordinated strategy and thus attain a higher level outcome.The outcome may not be highest in the present moment in case defecting is most profitable, but

in the long run it is because the other player is not likely to defect either. Trust and cooperative behaviour reinforce each other (Putnam, 1993, p.171). In this way, procedural rationality goes well together with trustworthy behaviour (*cf.* Sen, 1976, p.342). Trust may thus diminish the need for 'proofs of commitment to a strategy' so often sought for in game theory, in case agents share a common set of norms. The difference between procedural rationality and trust is that the former assumes a conscious decision while the latter refers to an unconscious pattern of behaviour. Agents simply consider one strategy the obvious one, as if their norms provide a focal point strategy. In case of a prisoners' dilemma type of problem, agents trust each other to choose the cooperative strategy instead of defecting, reasoning like: "Of course he wouldn't do that, as I wouldn't defect in his place". It is the 'of course' which makes the person trustworthy, because it indicates that defecting is not perceived as an option due to an internalized set of norms for fair behaviour. Both in case of coordination problems and in cases of conflicting interests, ethical norms limit the set of alternative actions, making behaviour more predictable (*cf.* Heiner, 1983; Putnam, 1993). This line of thought is explored for two cases: bilateral trust and societal trust.

5.2.1 Bilateral trust

Literature on trust in the context of contracting is of limited use for scrutinizing the role of trust in coordination, because in many coordination problems no contract is signed. In terms of game theory, a game in which a binding contract can be signed is called a cooperative game. In case the players cannot communicate, they cannot enter into a contract. As argued in chapter 4, many coordination problems do not allow for communication, so they are not of a cooperative type of game. Therefore, in this chapter, the use of the term 'cooperative behaviour' does not imply a cooperative game. Rather, it refers to an attitude, as in the definition by Fukuyama cited above. Furthermore, successful coordination need not depend on a contract (Ullmann-Margalit, 1977, p.76). Discussions on trust which relate to organization costs and

monitoring (*e.g.* Khalil 1994; Hart 1995) can therefore be left aside.

More relevant to coordination problems are the concepts of signalling and learning. In case of repeated coordination problems, agents can learn about the trustworthiness of others as well as signal their own trustworthiness. For instance, agents may refrain from exploiting profit opportunities which go at the expense of others in order to show their commitments to the others' well-being or to common social norms. Sako describes an agent who behaves this way as being worthy of 'goodwill trust'. Such a person "is dependable and can be endowed with high discretion, as he can be trusted to take initiatives while refraining from unfair advantage taking" (Sako, 1992, p.39). By conforming one's behaviour to social or ethical norms one lives up to other people's expectations of trustworthiness, which in turn is a signal of future reliability. The more often behaviour meets expectations, the more trust accumulates. Actual behaviour thus contains symbolic information concerning reliability, so that agents learn about the trustworthiness of others (Gill and Butler, 1996). One can say that trust increases with use while it diminishes if not used (Sako, 1992, p.41), but this leaves the notion of using trust unexplained. In case 'using trust' means 'living up to expectations,' trust increases by using it because actual behaviour confirms the expectations of trustworthiness. However, this effect holds for norms for behaviour in general, not for trust in particular (Putnam, 1993, p.170). Therefore, an alternative line of thought may be preferable. Metaphorically, trust can be interpreted as dividend from relationship capital, which consists of shared experiences and commonly held norms. Using trust can then be seen as spending the dividend instead of reinvesting it in the relationship capital, so that the stock of capital does not grow or even diminishes. In this metaphor, 'using trust' means *not* living up to the expectations others held of trustworthy behaviour, so that trust *de*creases with use. If trust is too heavily used, 'the account is overdrawn,' so that agents lose their reputation of trustworthiness. In case trust is put to the test very often, people become more aware of the riskiness of the situation they find themselves in and the importance of the fact that the other party can be trusted so that the relationship capital grows. Another aspect of the metaphor concerns the time

horizon. A relationship in which agents trust each other must be built up over time, during which agents can observe that the other party behaves according to the ethical norms they share. Oppositely, in case one agent depends on the other, claiming direct 'repayment' diminishes the trust (Sako, 1992, p.44). Insofar as investing in the relationship capital is rational, it is more of a procedural rationality[1] which is involved rather than an instrumental rationality. The actions themselves are not instantaneously profitable, but committing to trustworthy behaviour may be most profitable in the long run, or yield a non-material sense of utility.

In a word, trust is relevant in coordination problems for two reasons. Firstly, as trust stems from a common set of norms for behaviour, it facilitates the formation of expectations concerning behaviour of others and supports the confidence in these expectations. This is particularly relevant in pure coordination problems. Secondly, agents who trust each other feel sure about their mutual intention to cooperate. In a conflict situation, they achieve the cooperative strategy outcome instead of defecting at the possible expense of their counterpart. In a nonpure coordination problem, the agents can depend on their trust in each other while switching from the low pay-off coordinated strategy to the high pay-off coordinated strategy.

Four economic examples corresponding to each type of coordination problem can illustrate the argument that trust is relevant to coordination problems. A pure coordination problem can be the order of sending out goods and sending the payment in case of postal ordering. Coordination may either result in the seller sending the goods after which the buyer sends the money or the buyer first sending the money after which the goods are being sent to him. Both orders may be conventional, and may differ across countries or branches of industry. The risk involved is related to the vulnerability of the party who sends off first. In order for trade to proceed, the parties have to trust each other

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[1] The trust put in institutions can be called procedural trust (Gill and Butler, 1996). Procedural rationality is also relevant to explaining institutions (Rowe, 1989). In both cases, reference is made to a level higher than the individual and instantaneous rewards of actions, which may explain the common use of the term 'procedural.'

to stick to the conventional order of executing the transaction. They need to know that the other party conforms his behaviour to 'business practice' or other norms of 'fair' behaviour. In case trust is lacking, a legal framework is needed to secure both parties of a 'fair' trading procedure.[2] Otherwise, traders pay cash, as in informal economies. A nonpure coordination problem is encountered by firms who use a conventional term of payment, say three weeks. It could be more profitable for all players to switch to a shorter term, like one week, only if this becomes a new convention. Once the firms have managed to agree on a shorter period, they need to trust each other not to slip back into the old convention. A similar problem was faced by the American automobile industry, which managed to switch to a more profitable coordinated strategy by changing the timing of new model introduction (Cooper and Haltiwanger, 1993). Here, fierce competition prevented a shift to the more profitable coordinated outcome. The shift could only be made after a code for fair competition was issued by the President of the United States, requesting suppliers of automobiles to "enter into agreements with one another" (*ibid.*, p.1042), so that common norms for behaviour could emerge. A conflict situation is seen in the timing of a yearly recurring sales. The one who starts discounting attracts most customers, but is worse off in case others start still earlier next year. All shopkeepers profit if they can trust each other not to start before a commonly chosen moment, like January 1st. The same holds in case of only two shopkeepers, who may share the same local market. A mixed type of problem is the decision as to whether or not to switch to a common currency, like the decision faced by prospective EMU participants. If two or more countries switch to the common currency, they may be better off as compared to not doing so, *inter alia* because their citizens save transaction costs and gain the benefits of extended markets. However, if a country switches while the

[2] Another reason for making conventions part of legal rules has to do with the time horizon. The convention is a solution to the long-run societal pure coordination problem described. However, at any instance of this problem, a conflict element is involved, because both parties can free ride on each other's vulnerability. In game theoretic terms, the stage game is a mixed motive game, while the supergame is a coordination game. Many traffic rules, *e.g.* right of way, emerge from a similar situation.

countries it trades most with do not, it incurs the costs of switching without profiting substantially from saving future transaction costs. Here, trust is important for countries which prepare to switch, *e.g.* by reducing their governments' budget deficits and public debt. The countries which intend to do so, exchange signals of commitment in order to invest in their EMU-relationship and the trust which stems from it.

In case of conflict and mixed motive situations, a formal way of binding partners is often created in addition to the signalling of intentions. For instance, the timing of sales may be regulated and the switching to a common currency is agreed on in a treaty. However, contracts and regulations are seldom complete, so that there is always room for trust in order to accept the risk of unforeseen contingencies. Further, the basic attitude of complying with the contract or obeying the regulation cannot be formalised. For these 'non-contractual elements in contract' and for coordination situations, social norms and trust are relevant as well (Sako, 1992, p. 17). This is even more so in case many people are involved, as in society as a whole.

5.2.2 Societal trust

Whereas bilateral trust stems from a relationship between two entities in which a reputation of trustworthiness can be established, societal trust is more of an anonymous character. Although societal trust can be accumulated, it is not based on reputation. Instead, social norms are crucial to trust. Social norms are often complied with automatically, without conscious cost-benefit calculations. They allow people to generalize their expectations of others' behaviour. Institutions formalize these expectations because they prescribe behaviour and sanction deviating behaviour (*e.g.* Greif, 1992, 1993). In some sense, therefore, institutions confer trust (Allsopp, 1996, p.3). At the same time, institutions are able to persist because of the trust put into them. For instance, if many people stop trusting their banks or the central bank, a bank run or a shift to a foreign currency is fatal for the home banking system. In a less formalized structure, conventions indicate expected behaviour and are supported by the trust agents

have in compliance with the convention by others.

In the context of group interaction, a metaphor of trust as dividend from social capital can be used analogously to the metaphor of bilateral trust and relationship capital. Social capital can be defined as "the ability of people to work together for common purposes in groups and organizations" (Fukuyama, 1995, p.10). According to Fukuyama, social capital stems from people's "ability to associate," which is facilitated by shared norms and values in a community. It facilitates coordinated actions and spontaneous cooperation (Putnam, 1993, p.167). Social capital is different from physical capital in that it does not wear out while being used, but increases instead (Putnam, *ibid.*, p.169). Like norms which become more prevalent the more often they are used (*cf.* David, 1994, p.212), social capital becomes more of an asset the more people act upon it. Living up to the expectation of trustworthiness can be interpreted as a reinvestment of the 'dividend' in the stock of social capital (*cf.* Khalil, 1994, p.341). In the broader context of social relationships, the same phenomenon is observed, namely that sentiments accumulate with interactions, while the perceived intensity of relationships diminishes in case of fewer contacts (Van Dijk, 1997, p.53). The smaller a community, the higher the frequency of interactions, so that a social infrastructure evolves in which people tend to trust each other (*ibid.*, 1997, p.60). Figuratively, trust can be described as being subject to network externalities because of the positive feedback involved in using it. The size of a high trust society is limited by the social infrastructure which transmits the feedback. Beyond this size, free riding on societal trust becomes attractive so that the social capital diminishes. In other words, the more anonymity, the more difficulty a society may have in maintaining a high level of trust (*cf.* the description of the US in Fukuyama, 1995). This implies that trust is not universal: it is related to a limited group of agents who share social norms in a society which feeds back their behaviour.

Different levels of social capital invoke different amounts of trust among agents. The shared values make people subordinate their individual interests to those of larger groups, which makes people trust each other (Fukuyama, 1995, p.10). The reason why this is so, may be as follows. As long

as a person's interests coincide with his behaviour, his commitment to a pattern of behaviour, for instance complying with social norms, can not be discerned (Frankel, 1977, p.34). Trustworthiness can only be signalled if actual behaviour deviates from individually optimal, utility or profit maximizing behaviour every now and then. Therefore, people start trusting each other once they see that actual behaviour is consistent with social norms even if they do not serve individual interests. Fukuyama's line of thought can be interpreted as the multi person equivalent of 'goodwill trust', which makes people refrain from exploiting profit opportunities in bilateral relationships (Sako, 1992, p.39). The difference between trust in a two-person relationship and a society lies in the way the interaction is repeated. In a bilateral relationship, trust emerges in repeated interactions, so that a reputation can be established. For trust to exist in a multiperson context, the persons need to perceive themselves as part of a limited community. In terms of game theory, the players are drawn from a finite population. Like evolutionary game theory underpins the emergence of conventions in a finite population, sociology argues that in a community trust can emerge from shared norms and values. Shared norms and values enable agents to form expectations on other agents' behaviour and have confidence in their expectations. In case agents meet once, they have to rely on such shared norms in forming their expectations, since they are unable to learn from repeated interactions. This makes agents more likely to trust each other, which enables them to enter transactions, to build up a trading relationship, and to engage in contracting. Trust enables markets to function because it facilitates the establishment of trading relationships, which reduces markets' set-up costs, particularly in markets in which bilateral trading relationships are important (*cf.* Clower and Howitt, 1994, p.9). In this way, coordination is facilitated in an economy. It allows people to run risks because they can rely on others, who behave in accordance with common norms. Risky investments are more easily made once agents trust each other and rely on their investment partners. A high level of trust may thus cause a high level of output of an economy (Arrow, 1974, p.26)

5.3 Trust and Institutions

Analysing the trust people put in institutions has the implication that the institution is treated as a separate entity: methodological individualism cannot be maintained (*cf.* Janssen, 1993, p.xiii). This implication is not unique to an analysis of trust. Instead, it is present in most explanations of institutions. In order to avoid the danger of personalizing institutions, they can be perceived as originating from self-organization by individuals (Orléan, 1992, p.116). Interpreting institutions as a way of self-organization often implicitly assumes a form of rational intention, or at least a conscious creation of institutions. If a conscious creation of institution is not assumed, an evolution towards some degree of self-organization can still be the outcome, but the institution itself may be less adequate (*cf.* David, 1994, p.217). Still, they may be an element of a self-organizing economy. Insofar as trust follows from social norms, which may be embodied in culture and habits in such way that even the norms are not explicit, explaining the role of trust in sustaining institutions is likely to be incompatible with methodological individualism. The outcome of individual behaviour is not always one-to-one related to this behaviour, because the trustworthiness of individual behaviour, or the lack of it, spills over to the social capital. Individual behaviour is not only determined by economic motivations from costs and benefits, but by compliance with social norms as well. As a result, the individual decides not only upon his own costs and benefits, but is influenced by social norms as well. In terms of economics, the micro behaviour is partly macro founded. These social norms may be procedurally rational, but are likely to be so to a limited extent, as many social norms are not consciously created. Therefore, an analysis of the role of trust in sustaining institutions must go beyond individual behaviour and take social externalities of individual behaviour into account.

Institutions provide a way of coping with coordination problems. Informal institutions, or conventions, are based on voluntary and often implicit coordination, in which norms and habits provide focal points. Formal institutions explicitly aim at coordinating strategies by sanctioning deviating actions. Institutions emerge over time, as long-run relations evolve in which

people trust each other. Short-run relations in which trust plays a role are hard to imagine. Markets are an impersonal institution which takes care of transactions by providing an encompassing framework of rules and practices, backed by a legal system. At markets, the trust in reciprocal bartering obligations is replaced by the trust in money and monetary institutions (Gill and Butler, 1996, p.83). In countries as a whole, different institutional frameworks can only emerge over time, and are often determined by historical events (Soskice, 1991, p.49; David, 1994). For instance, the trust shareholders put in annual reports of firms is related to the amount of trust shareholders have in managers. In low trust countries, only familiar people like old schoolmates are appointed manager (Fukuyama, 1995). The impact of this low trust attitude on the profitability of firms as well as on the possibility of trading relationships which go beyond the circle of family or neighbourhood members may result in growth differentials between economies (Fukuyama, 1995, Chs. 28, 29).

Trust and institutions are related in two ways, which feed back upon each other. Institutions facilitate the trust among members of an economy, and trust put in institutions contributes to their well-functioning. As trust is difficult to measure, the arguments underlying the relationship may be more relevant than figures. One of these arguments is the externality aspect of trust in institutions. Once people start trusting an institution, like a government or a banking system, this fact alone makes others trust it as well, apart from 'fundamental' characteristics which may make banks or governments trustworthy. The externality aspect is of a conventional nature: once people trust an institution because they know others trust it, it may become conventional to trust it themselves. Institutions which operate on markets with asymmetric information may be the best case in point, such as (medical) insurance schemes, pension funds, and banks. Like personal trust provides information concerning the likely behaviour of others in a coordination problem, the trust put in an institution by some people provides additional subjective information on the likely way this institution treats other people. This externality aspect extrapolates the level of presence or absence of trust from the

individual level to the social level, which underpins the division between a high trust and a low trust economy as described by economic sociologists.

From a behaviour point of view, another argument connects institutions and trust besides the externality aspect of trust in terms of information, which is equally relevant in the context of coordination problems. By fixing rules for interaction, institutions make behaviour become more predictable. Transactions between and among individuals and firms confirm to a stable set of expectations as a result of this institutional-based trust (Zucker, 1986, pp.99-100). So, trust and institutions can be said to be causally related in either direction. A related question concerns their degree of substitutability. Trust supports institutions: the presence of trust is necessary for institutions to exist. If agents do not trust each other, they doubt the reliability of others, which hampers coordination. Many institutions are enforced by sanctions, but often room remains for deviating behaviour, at least in the short run. An example is the execution of contracts in a society with a legal system and monetary institutions, which still relies on trustworthy behaviour as contracting would become too expensive or outright impossible otherwise (Granovetter, 1985, p.60). Moreover, contracts are seldomly complete, because contracting all future contingencies in detail is impossible or very expensive (Hart, 1995, p.2). On the other hand, contracts can govern behaviour to an important extent, which makes them useful. The same holds for other institutions, like governments, the law or hierarchical organizations: they also govern behaviour so that not all expectations need to be built upon trust alone. This line of reasoning leads to the conclusion that trust and institutions are substitutes as well as complements. They are substitutable to some extent, but not entirely, since institutions cannot exist without a minimal degree of trust (Granovetter, 1985, p.59).[3] In case of coordination problems without conflict, trust in the other party's rationality is necessary. For instance, trusting oncoming traffic to keep its side of the road boils down to trusting the drivers to be rational. Even if people from a small

[3] As a besides, one can think of trust without institutions, like trusting someone to be silent about something secret. However, as institutions are the object of study here, the conclusion is drawn from the point of view of institutions.

community, who share a local set of ethical norms, do business together without formal contracting because they trust each other, the informal set of reciprocal expectations and the monitoring of behaviour by the community still act as an institution. Social exclusion from the small community can be an effective threat which prevents deviating behaviour. Other examples are the theories of implicit contracts and customer markets (Okun, 1981), which suggest that people rely on each other to behave in some way without making their expectations explicitly known to each other. Instead, they build a reputation by signalling their commitment to the relationship. To sum up, trust and institutions are both causally related and partly substitutable.

5.4 The high trust economy

The concept of trust is easier recognized at the bilateral level than at a societal level. People prefer to transact with people they personally know to be trustworthy, or who have a reputation of reliability, rather than to deal on the basis of a shared set of cultural norms alone (Granovetter, 1985, p.60). Therefore, realism increases once the impact of trust at both levels is assessed simultaneously. The implications for the role of trust in society can be seen in the way transactions are organized. Market transactions and transactions which are internalized in a hierarchical firm can be seen as extremes of impersonal and personal transactions, respectively (Gill and Butler, 1996, p.83). The same holds for transactions within a family or neighbourhood versus transactions between citizens of the same country who do not know each other personally. In a small group, people can monitor each other as well as make frequent investments in their social capital, while in very large groups, the risk of free-riding is large (Fukuyama, 1995, p.25). In between the extremes, a network structure may exist. Firms or people who share a set of norms, like 'good business practice' prescribes, form a network with trust among its members (Fukuyama, 1995, Ch.17). The members have bilateral relationships with each other and together constitute a group with shared social capital, in which information can disseminate fast (Van Dijk, 1997, p.60). The same can be said

to hold for networks of firms. Often, cartel regulation forbids explicit coordination of firms' strategies. However, it can be argued that such regulation hampers efficiency to the extent that case cartels and other forms of institutionalized coordination can contribute to self-regulation of markets. In case they are prohibited, either they continue illegally or takeovers increase. A sector which used to regulate itself may thus end up as a monopoly (Senstius, 1995; Van Waarden, 1995). While networks may combine the benefits of markets with those of hierarchies, monopolies only exploit the latter. These three types of organizations of firms and industries can also be seen at the level of the economy.

For countries as a whole, different levels of trust can work out in different types of institutional organization of the economic system. The basic set of institutions of many economies consists of a monetary system, ownership rights and contract laws (Van Waarden, 1995, p.54). In addition to this minimum, other institutions can be created. Economies can be seen as a mixture of three elements, each with their own balance between government regulation, self-regulation and markets (Senstius, 1995). Only the middle element goes together with a relatively high level of trust (*cf.* Putnam, 1993, pp.171-175). A low trust economy tends to be organized either as 'statist-hierarchical', like France, or as 'deregulated and contract based,' like the United States or the United Kingdom (Soskice, 1991, pp.48-49). In an economy with heavy government regulation, transactions are internalized within the hierarchy of the government. In an economy which emphasizes market transactions, contracts provide a way of regulation. As can be seen in the US, private contracts are supplemented by legal procedures which are invoked in cases of conflict. Therefore, in both types of economies, the low level of trust is compensated by some form of explicit government regulation. A high degree of trust facilitates a 'consensus-based economy,' like the Rhine lands countries of North-West Europe demonstrate. Here, self-regulation by trade associations, management unions, industry councils, and the like, facilitate coordination, so that this third type can be called a 'flexibly coordinated model' (Soskice, 1991, pp.48-49). It

seems to be equal to Fukuyama's description of a network economy, or to 'organized capitalism' (Fukuyama, 1995; Van Waarden, 1995). In a flexibly coordinated network economy, trust is most relevant. The two similar frameworks can be represented as follows:[4]

table 5.1

	firm / industry		country	
high trust	network		flexibly coordinated	
low trust	hierarchy	market	statist-hierarchical	contract-based
	centralized	decentralized	centralized	decentralized

In a low trust economy, conflicts are resolved either by hierarchical institutions, like strong governments and laws, or by the combination of contracts and enforcement by way of lawsuits. Because of the lack of trust, compliance needs to be enforced by institutional sanctions, so that formal institutions predominate informal ones. If an economy is oriented towards conflicts, more contracts need to be drawn and more cases need to be filed, which raises transaction costs (Fukuyama, 1995, pp.27, 151). The United States and the United Kingdom are different from the Rhine lands economies in this respect (Albert, 1993). In a high trust economy, as in the Rhine lands countries, voluntary compliance allows for self-regulation. The resulting institutions are less formalized and are often accompanied by conventions. The combination of explicit and implicit coordination makes institutions different from markets and hierarchical organizations (*cf.* Ménard, 1995). Particularly in implicit coordination, trust is

[4] In terms of Hofstede's (power distance / uncertainty avoidance) typology of implicit models of organization in different cultures (Hofstede, 1980, p.319) the following similarities can be discerned: the 'pyramid' model resembles the statist-hierarchical economy; the 'family' model resembles Fukuyama's description of family-oriented, low-trust economies; the 'market' model resembles the contract-based economy; but the 'machine' model may not be similar to the network economy. A comparable observation was made by Wursten, who complemented Hofstede's typology with a fifth model, which he called a 'network' model (Kwarten, 1997). Both the 'machine' and a 'network' model can be characterized as high-trust.

important for predicting behaviour by one's counterpart. Of course, the three types of economies are benchmarks, so that in many real-world economies behaviour is regulated by more types of norms which solve the 'mixed-motive' problems these economies face. At the same time, governments may try to balance the creation of incentives with the reduction of uncertainty (Van Waarden, 1995).[5] The present movement towards deregulation the Dutch government implements in the economy can be interpreted as a shift from risk-aversion towards incentive-creation. In case the orientation towards consensus, which characterizes the Dutch corporatist economy, can be preserved, the increased market-orientation may go together with a high level of trust.

The role of a government can be smaller the more agents are able to self-organize by means of networks and institutions (Van Dijk, 1997, p.63). Examples are the bar of lawyers, associations of accountants and notaries and the mediaeval guilds. The networks allow for transactions beyond a small group and trust in institutions can be maintained because the institutions follow from self-organizational activities which are facilitated by the common social capital (Van Dijk, 1997, p.51). As an indicator of the level of trust in an economy, Putnam (1993) gives the examples of political participation rates, newspapers readership, and membership of local sports clubs. Institutions contribute to a higher level of trust by depersonalizing transactions in two ways. Firstly, they are exclusive to members of a same subculture, like a religious denomination, so that these members can trust each other to be of the same background.[6] Secondly, other institutions function as an intermediary

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[5] The two long-term future scenario's launched by Shell in 1996 are compatible with the two extremes. By the phrase of TINA: 'There Is No Alternative,' Shell takes three developments as given: liberalisation, globalisation, and (information) technology. In the 'Just Do It' scenario, individual consumers and producers quickly adapt to the developments, but achieve only short-run succes. The 'Da Wo' scenario describes a long- term orientation towards community building, which is less succesful in the short run, but more succesful in the long run (Kat, 1997). 'Just Do It' is built upon incentives, while 'Da Wo' may have the effect of uncertainty reduction.

[6] However, the high trust within groups of members of the same subculture may go at the expense of trust between such groups, that is, across subcultures, so that the effect on society as a whole may be ambiguous (Knack and Keefer, 1997, p.25).

mechanism between subcultures by providing a guarantee, like supervisory institutions do (Zucker, 1986, p.61). The less agents of different subcultures trust each other, the more the intermediary mechanisms are needed in order to facilitate transactions across subcultures.

5.5 Trust, money, and nominal prices

After the above discussion on the role of trust in sustaining conventions, or informal institutions, and in sustaining formal institutions, the line of thought is applied to the two institutions of money and nominal pricing rules which are intrinsic to an economy with indirect exchange. Several examples of norms are related to the use of money. The initial choice of any commonly accepted means of exchange is a coordination problem because of the network externalities involved, so that the use of a particular type of coins and banknotes is a convention. Often, the evolution of coins and banknotes had a path-dependent character in which past period outcomes served as focal points in the coordination problem. Later, coining became an institution because falsifying coins was prohibited and sanctioned. The high punishments, up till death sentence, that were given to counterfeit coiners, are in accordance with both the profit that could be gained by counterfeiting and the high costs of coordinating on a medium of exchange, that is, restoring and maintaining trust in it. The declaration of particular coins as legal means of payment thus removed uncertainty with respect to the quality and weight of the precious metal used as a means of exchange. For banknotes, the status of official means of payment secured their backing by a circulation bank. Here, trust in the bank is more important than legislation. This is also seen in communities that use 'local money'.[7]

To sum up, the selection of a commodity which is to function as a medium of exchange is a coordination problem. The preservation of the value

[7]At present, successful experiments with LETS (Local Exchange Trading Systems) are done in Australia, New Zealand, Great Britain, and the Netherlands (Aktie Strohalm, 1994).

of a fiduciary money is sustained by legal and monetary institutions which solve the underlying conflict problem. The present section discusses the role of trust in sustaining these conventions and institutions of a monetary economy. Firstly, the case is made that the conventional use of money and the institutions that facilitate the use of it require some degree of trust. In any economy with historical time, trust is relevant. Besides knowledge, some confidence is necessary for investors to make them invest in projects with future yields, for traders to buy goods they expect to sell, and for farmers to sow their seeds (Simmel, 1907, p.179). However, in a monetary economy, the importance of trust goes beyond confidence in the future: money is also a manifestation of shared belief in the acceptance of the token by others in future exchange. The trust in money is enhanced by the imprint of national symbols, which have a subjective value to the country's population of money users. Moreover, credit entails trust in the debtor's ability to pay the debt (*ibid.*). Secondly, the monetary unit must be trusted in order for nominal prices to perform their coordinating function properly. The statement that nominal prices cannot do without a unit of account is thus more than a tautology. Nominal prices as well as money are relevant to bilateral trading relations and the functioning of the economy as a whole. Therefore, the above discussions on bilateral trust and social trust both apply. Trust may even provide a connection between the two, as the trustworthiness of individual behaviour feeds back upon social capital and the level of trust in the economy facilitates or hampers the creation of bilateral trust. With respect to money and prices, a similar feedback relationship between bilateral exchange and macroeconomic coordination problems exists. The next sections discuss the role of trust in such coordination problems.

5.5.1 Trade and trust

The presence or absence of trust, either of the bilateral or of the social type, has an impact upon the way agents trade. If the level of bilateral as well as social trust is very low, trade is not likely to occur at all. Even in case of bartering, some trust is needed. For instance, one has to trust one's trading partner about

the stated quality of the goods or the terms of delivery (*cf.* Fukuyama, 1995, p.311). At an even more basic level, one has to trust the other person to honestly claim the right to sell a good because of being its legal owner (*cf.* Hicks, 1969, p.34). The fact that a legal system can be invoked once these rights are faked, is of more help afterwards than at the moment of trading. Once some degree of social capital and trust are present, 'normal' barter trade can take place (*ibid.*, p.35). Examples of such barter trade are seen in informal economies and in economies during hyperinflation. In situations like these, several reasons for money not to develop or persist may be present. One of them is that societal trust is too low for money to function. In that case, both hyperinflation and barter can be seen as symtoms of decay of the monetary economy. Still, some social infrastructure may exist so that bartering among people who do not know each other personally can take place. For instance, people only trade with relatives or 'friends of friends' instead of other people they do not know personally (*cf.* De Soto, 1989, p.166).

A rather different case of barter trade occurs among people with a high level of relationship trust. Transactions between people who know each other very well are often not executed in terms of money. The costs of trading and marketing all individual exchanges of services in small communities would involve high transactions costs, which are not made up for by the possible allocative benefits (Goodhart, 1989, p.30). Goods may be paid for, but services are seldomly paid for with money. Examples are transactions involving parents who do not want to be paid by their children, colleagues who don't ask each other to pay for giving advice, and friends who listen to each other's problems but are not paid, whereas a therapist might do just the same and receive payment instead (Klamer, 1996). In these cases, paying money may even be a taboo or be interpreted as a sign of distrust. By not paying, people invest in the relationship capital because they signal that they trust the other party to offer an equally valuable service in return, later in time. The willingness of both parties to offer future services for free is likely to decrease once a money payment is made, because the informal relationship which served as a basis for the service becomes a formalized service trading relationship (Frey, 1997, pp.7-

8). The exchange of goods and services without payment can be called a pure credit economy, though a very informal one as any explicit reference to credit injures the relationship. A direct payment, even in terms of an equivalent service, could signal distrust or be interpreted as the intention to end the relationship soon. From the point of view of prices, there is another implication: the prices of the services are not clearly set. Being explicit about exact prices can be as much of an offense as paying directly. Somehow, some degree of 'opacity' is necessary for the informal system to function well. The 'price' of a good or service transacted has to be subjectively estimated. As long as both parties involved have the same subjective valuation, this intersubjectivity takes care of mutual satisfaction with the 'trade'. However, if intersubjectivity is lacking, the expectations are not compatible and a conflict may result. The implicit character of the prices of barter trader in personal relationships, or very small communities such as families, makes price rigidity likely to occur. Relative prices thus move within a range which is intersubjectively determined. Still, as no unit of account is involved, nothing can be said in terms of nominal prices.

After the three cases of low social trust, low bilateral trust and high bilateral trust, the fourth case of high social trust remains to be discussed. Social trust makes the creation and persistence of institutions possible. As the convention of money and the institutions of the monetary system partly depend on this trust, monetary exchange occurs in economies with at least some minimal degree of social trust. The awareness of belonging to the same group preceeds the investment in social capital and the trust which stems from it. The social trust secures that money is generally accepted, that price setters engage in trades once they are offered the sum of money they quote as price, that money is backed by a central bank, *et cetera*. Remarkably, the relatively high level of social trust allows bilateral trust to be lower without inhibiting trade. The use of money facilitates trading by people who belong to the same group but do not know each other, so that specialization can take place. Depending on the culture of a country, the group can have the size of a family, a clan, or all citizens of a country. Social trust thus facilitates indirect exchange, specialization, and the welfare increase which result from these two. Bilateral

trust among the trading partners can be partly replaced by social trust in money, markets, regulation, and accompanying institutions. In case bilateral trust is extremely low, the social trust which supports money cannot compensate the lack of bilateral trust, so that the two are only to a limited extent substitutable. For example, in the drugs scene, informal codes of conduct govern trade. Deviating behaviour is sanctioned heavily, *e.g.* by threat of murder, so that compliance is enforced. In this example, the institution of a gang has partly replaced bilateral trust, while use is made of the social trust which supports the convention of money. In the legal sector, limited bilateral trust is supplemented by regulation and civil law, which secure the enforcement of trading contracts.

The four cases just discussed can be summarized as follows:

table 5.2: trust and exchange

		social trust	
		high	low
bilateral trust	high	monetary trade and service bartering ("implicit pure credit economy")	barter trade (direct exchange)
	low	monetary trade (indirect exchange)	little or no trade

The relationship between bilateral trust and social trust or, analoguously, between relationship capital and social capital, can be elaborated further. To some extent, the two reinforce each other. The more relationship capital is created by people behaving in a trustworthy fashion, the more networks of trading relationships can be established. Together, these networks create an economy in which people share fair trade practices and other kinds of norms for behaviour, so that opportunities for specialization and trade are exploited. The newly established Local Exchange Trading Systems are examples of such networks. Participants in these networks trust each other to set fair prices and they trust the central administration office to be a reliable bookkeeper. They

differ from the examples of intersubjectively set 'prices' given above in that a unit of account is used, so that prices can be set explicitly and exactly. By the use of a unit of account, the prices are nominal prices instead of relative ones. However, as long as no credit is given to participants in the LETS, the general price level can remain stable. Social capital also reinforces relationship capital, as people easier start building up a bilateral trading relationship in case they share norms for behaviour, so that they know which behaviour they can expect of others. For example, people of the same ethnic group tend to trade with each other rather than with people from other ethnic groups. Bilateral relationships are also supported by social institutions, such as laws and arbitrage committees. In a word, relationship capital and social capital reinforce each other by the trust derived from both kinds of capital. The relationship also holds in the downward direction. For instance, in a recession, traders are tempted to exploit all profit opportunities available to them in spite of a reputation of fairness they might have. Thus, they 'spend' the trust given to them so that the relationship capital diminishes. The diminishing trust at the bilateral level makes social trust more crucial for the economy to function, but tends to undermine social trust as well. Formal institutions like price regulation may be needed in order for trade to proceed. In case even such formal norms are not complied with, a state of anarchy is more likely than one of regular trade, as can be seen during times of political turmoil. A lack of social trust can also feed back upon bilateral trust to the extent that basic facilities necessary for trade are not created. For instance, legal property rights, a banking system, and orderly markets make people willing to take the risk of trading with someone they don't know. In case a supportive context is lacking, new trading relationships are less likely to be built up, so that bilateral trust cannot accumulate.

To sum up, a positive relationship rather than a trade-off between the two levels of trust exists. A high level of social trust is necessary for exchange to become indirect. As a monetary economy is defined as an economy with indirect exchange, it follows that a monetary economy must be a high trust economy.

5.5.2 Trust and Money

In a monetary economy, exchange is indirect. Either a commodity money or a token money intermediates the selling and buying of goods and services. The value of money hinges upon the expectation of its future acceptance by others, which makes money different from other goods. During the evolution of money from a commodity money to a token money, its material value decreased, so that money's nominal value became higher relative to its intrinsic value. The value of money became determined by its liquidity and its legitimacy, rather than by the value of the material it was made of. The difference between the aspects of liquidity and legitimacy stems from the point of view of analysis: Keynes focuses on liquidity whereas Orléan considers legitimacy crucial. The two approaches are combined here, because the essence of liquidity and legitimacy are the same from the point of view of coordination. Both are derived from the expectation of future acceptance. In a monetary economy, information on which expectations can be based is limited. In case of a token money, the probability of future acceptance cannot hinge upon the intrinsic value of money alone. The trust in money as a symbol of wealth, as well as the trust in the monetary system that secures its exchange value, contribute to the functioning of money. Thus, trust is a necessary condition for money to fulfill its role as a device for coordination. It is not a sufficient condition, since money cannot function on the basis of trust alone. The connection with some commodity suggests that the supply of money is not perfectly elastic, but limited instead. Both Keynes and Simmel pointed out that the limited supply of money is essential for it to function. A limited supply of money in the past makes a limited supply in the future relatively likely, so that money can be trusted to maintain its purchasing power. Keynes rationalizes the value of money by arguing that the liquidity of money makes people accept it in indirect exchange. Simmel explicitly adds the aspect of trust. He asserts that money transactions would collapse without trust, and that money has to have some residual material value (Simmel, 1907, pp.179, and 158, respectively). The paradox is that money tends to evolve towards diminishing material value but will fail to function once its material content has approached zero (*ibid.*, p.165).

A possible interpretation of this 'Simmel-paradox' results in an infinite regress: the value of money today depends upon its value yesterday, which depends upon its value the day before yesterday, and so on. The regress becomes finite once the stage of a full-commodity money is reached, in which money is essentially indistinguishable from other commodities (Selgin, 1993, p.4). Following this line of reasoning by Von Mises, Selgin argues that a new money has to be linked to a commodity money in order to be valued (*ibid.*, p.5). However, the more money's nominal value increases relative to its intrinsic value, the less convincing this argument becomes. To what extent do people value money for the very reason that it used to be linked with gold on a one-to-one basis? The paradox may rather be interpreted along the line of the impact of trust set out above. Then, some amount of gold kept at a central bank serves as a focal point for trust. Although at present most people know that modern money is no longer linked with gold, the gold has become a symbol for the trustworthiness of the central bank. As long as people share the symbol, it can function as an anchor for expectations. The number and contents of press articles after a sales of gold by central banks underpins this interpretation. A related focal point is the person who presides the central bank. The reputation of the central bank's president and the statements s/he makes provide an anchor for expectations. These statements not always contain substantial new information, but their symbolic information makes them useful as a signal of reliability. The same holds for the impact of press interviews given by people who personalize other institutions that are supported by trust, such as governments.

The conventional character of money implies that a choice theoretic, methodological individualistic explanation as to its use is bound to be incomplete. Even in situations of 'social transparency', that is, even if all agents know of the conventional character of money, the coordination problem involved, and the ways in which it can be solved, this perfect knowledge does not secure a coordinated, let alone a stable, outcome. The indeterminacy of the outcome can be explained from the point of view of game theory (Gilbert, 1990; see chapter 4) or from an analysis of the history of money, which shows that

path dependence has played a larger role in the emergence of money than the 'fundamental' characteristics of the commodity which performed money's functions (Orléan, 1992, p.125). In other words, methodological individualism and 'social transparancy' are insufficient. The latter may even be unneccessary, because individuals who are not aware of the conventional character of money may still use it as long as they do know that money is generally accepted or they may imitate others who succesfully use money (Wärneryd, 1989, p.616). Orléan even argues that knowledge of the conventional character of money is harmful, because the suggestion of arbitrariness which follows from this knowledge undermines the perceived value of money. For money to function as a store of value, it would be better if there were some 'opacity', which causes people to believe that money's value is derived, at least partly, from its material form or its former link to gold. Put differently, "there is a necessary gap between the beliefs and the formal model" (Orléan, 1992, p.126). By this line of thought, Orléan solves the Simmel-paradox. The more money becomes of a fiduciary character, the greater the necessity of beliefs in order for money to be generally accepted.

The question as to what feature bridges the gap can be answered in several ways. According to Orléan, the *legitimacy* of money complements its material value, so that money is valued (1992, p.127). Other terms which seem to denote the same are "an *implicit guarantee* given by the community" (Laidler and Rowe, 1980. p.99) or a "social-psychological quasi-religious *faith*" (Simmel, 1907, p.179).[8] Van Ees and Garretsen focus on ignorance, or lack of knowledge, which makes agents trust monetary institutions and conventions (1995, pp.284-286). They argue that *beliefs* held by agents make monetary institutions and conventions able to persist. Like this chapter argues, the role of trust is considered important as well. In the present framework, *trust* is essential for

[8] Given the combination of these quotations on one page of their article, it is remarkable that Laidler and Rowe consider Simmel's concept of trust as being closely related to "the informational content of money" (1980, p.99 fn.4). All other authors cited here point out that money differs from other goods by some characteristic which can *not* be reduced to information.

bridging the gap. In an economy in which agents share a social and cultural background, features of some medium may become prevalent so that this medium is a focal point: it becomes the obvious embodiment of trust. The monetary institutions which support it contribute to the confidence in money. As in any credit situation, this trust relates to the future in general (Simmel, 1907, p.179), to the creditworthiness of others who use money, to the future state of the economy, and to monetary institutions such as banks. Analogously to the role of the game theoretic 'common knowledge assumption' in explaining conventions, a 'common trust assumption' can be made for money: once people trust others to trust a money, they tend to do so as well, not because they know of the coordination problem, but because they base their expectations upon this trust. Moreover, once people trust others to take care of the organization of the monetary economy, they trust the money which results from this organization. Like common knowledge is necessary but insufficient for explaining conventions, common trust is necessary but insufficient for explaining money, since it does not indicate which medium to trust. However, a focal point is provided by the source of trust, being a common cultural and ethical background. Precisely because of the lack of 'social transparancy', reference can be and is made to external objects (Orléan, 1992, p.126). Once such an object becomes a focal point, expectations converge to commonly shared beliefs, so that behaviour becomes predictable and coordination can be attained. Again, the gold held bij central banks serve as an example (Van Ees and Garretsen, 1995, p.285). The external effect of trust sustains the convention of monetary exchange. The same external effect makes changes to other conventions difficult. For instance, the acceptance of plastic means of exchange had to be forced by tariffs imposed by banks in order to make people use them. In the game theoretic framework of a nonpure coordination problem, a shift from the low pay-off coordinated strategy to the high pay-off coordinated strategy had to be made.

Another aspect of the relationship between money and trust refers to the stability of the economy. By hoarding money, agents show distrust in the future. They prefer to keep their purchasing power instead of spending it,

because they expect the future to offer more profitable options than are available in the present (Laidler, 1984). Paradoxically, trust is put in the very convention of money, with the intention to spend it in the same distrusted future (Van Ees and Garretsen, 1995, p.285). Irrational as this may seem, the fact that all people turn to the same money secures the stability of this particular convention. It ensures that people will find a counterpart once they want to spend their money. The hoarding behaviour becomes a problem once all agents turn to money at the same time, because a society as a whole cannot hoard more in case of common distrust (*ibid.*). Moreover, the fact that the aggregate liquidity preference changes must imply that agents react differently to the same economic facts (*ibid.*), so that the economy cannot consist of homogeneous agents. The issue of the timing of the hoarding can be distinguished from the analysis of the selection of the medium to hoard. As long as agents hoard at different moments of time, money remains liquid. Money can function as a store of value precisely because all agents choose to hold it and want to hold it at different times, so that money has the highest liquidity premium. The liquidity, or degree of acceptance of money depends on the expected inflation rate and the trust in monetary institutions, such as banks. A way in which conscious use is made of focal points is found in inflation targeting (IMF, 1996, p.362). The reference to the rate of inflation brings the discussion to the topic of nominal prices.

5.5.3 Nominal Prices and Trust

By facilitating the use of money, trust contributes to indirect trade. As compared to barter trade, a more efficient allocation can be achieved by using money. A better coordination is achieved by the dissemination of information which is facilitated by nominal prices. Nominal prices save information costs only in case the denominator is stable (Niehans, 1978, p.122). In times of hyperinflation, for instance, money no longer functions as a unit of account nor as a medium of exchange. Agents no longer trust the monetary institutions to maintain the purchasing power of money, so that the trust in the monetary unit

diminishes as well. As nominal prices are set in terms of the monetary unit, they no longer perform their functions of communicating information on scarcities, quality, and reputation. Therefore, in order for nominal prices to perform their functions, some degree of social trust is necessary.

Nominal prices perform at least four functions. Firstly, they give information on demand and supply conditions on a particular market. They reveal both the scarcity of goods or services and the degree of concentration of suppliers and demanders. Secondly, nominal prices indicate the rate of inflation in an economy. The relationship between individual nominal prices and the rate of inflation, being the change in the nominal price level, goes two ways. All nominal prices together constitute the general price level, so that changes in individual nominal prices are reflected in changes in the general price level. The other way around holds in case individual nominal prices are adjusted to the rate of inflation by an indexation clause. Thirdly, nominal prices can indicate the quality of the items offered, as was discussed in chapter 3. Fourthly, nominal prices may signal the reliability of the price setter. It can be procedurally rational to build a reputation of trustworthiness among one's customers, because this contributes to customer loyalty. In terms of instrumental rationality, however, a trade-off may exist between efficiency and trustworthiness. The first one assumes every profit opportunity to be exploited, whereas the latter one may require some profit opportunities to remain unexploited in order to signal commitment to the buyer-seller relationship. The latter is procedurally rational as long as increased cutomer loyalty pays off in terms of continued sales and future profits. In case norms of fairness are shared in an economy, these rules for behaviour govern trade transactions. People then rely on each other because they know they share the same norms for behaviour. In local economies, such as those in which people are of the same religious denomination, this aspect can clearly be observed (Fukuyama, 1995, p.46). It also plays a role in international trading, in which differences between cultures can be interpreted or misunderstood as a lack of reliability of the other party. Nominal prices can then serve as a communicating device, signalling the commitment of parties to the trading relationship. As a possible result, mark-

ups may differ over time in order to maintain the same nominal price. By implication, a short-run trade-off between profits and bilateral or social capital exists. In the long run, the bilateral trust gained by investing in trading relationships may make up for temporary smaller mark-ups. Thus, the role of trust in price setting behaviour is reflected in rigid nominal prices.

As was argued in chapter 3, by complying to norms, price setters make their behaviour more predictable. The resulting limited flexibility of nominal prices facilitates a better coordination, although this may partly go at the expense of efficiency of the allocation. Nominal price rigidity contributes to predictable behaviour and thereby enhances bilateral and social capital. Trust supports both the money in which prices are denominated and the trading relationships in which prices communicate buying and selling intentions. Trust is thus related to the trade-off between the allocative and the coordinative processes in the economy.

5.6 Conclusion

The relevance of trust in supporting institutions consists of two elements, which together comprise the definition of trust presently used. Firstly, trust provides information concerning the behaviour of others. Secondly, it is derived from commonly held ethical norms, which support belief in other agents' intention towards achieving an outcome that benefits all involved, instead of pursuing one's own profits. Both aspects of trust are relevant in case of coordination problems, both in solving conflicts and in achieving the highest possible outcome. This argument is applied to conventions and institutions which relate to money and nominal price setting behaviour. Both kinds of norms for coordinating behaviour are supported by trust. At the bilateral level, nominal price rigidities can be an instrument of communicating reliability. These nominal prices can only contribute to coordination if the unit of account is trusted to be stable, which implies trust in the central bank and the banking system, as well as other institutions such as the government and the legal system. At the social level, the commonly accepted money makes agents willing

to use it, so that the efficiency gains of specialization and indirect trade can be realized. Common ethical values enable trust to facilitate coordination and stability of the economy.

6 Stability of a Monetary Economy

6.1 Introduction

This book focuses on the essential differences between a barter exchange economy and a monetary economy, particularly with respect to the role played by nominal price rigidity in inhibiting or promoting stability and growth. In chapter 2 it was concluded that fundamental uncertainty and historical time are essential to the use of money and indirect exchange. Chapter 3 argued that nominal prices perform other functions besides reflecting scarcity, as they may also communicate commitment to a seller-customer relationship, be part of an implicit contract, or signal reliability of the price setter. In chapter 4, coordination problems were studied. It was argued that conventions and institutions can serve as means to solve these problems. Chapter 5 focused on the role of trust in solving coordination problems, and gave some examples of the way trust is related tot the use of money and to nominal price rigidity.

The present chapter focuses on the implications of the use of money for the stability of a monetary economy.[1] First, theories on cumulative processes of inflation or deflation will be discussed. Second, the way uncertainty is dealt with in goods markets and the labour market is scrutinized. The impact of fundamental uncertainty and historical time on the decisions consumers and investors face, as well the conventions and institutions that exist in wage and price setting behaviour are connected in order to arrive at an integration of theories on the stability of the economy as a whole with theories with respect to coordination at the micro level. Conventions and institutions contribute to the mitigation of uncertainty at the level of the individual consumers and producers as well as at the market level. Third, the argument is developed that the impact of such conventions and institutions at the level of the economy as

[1] Parts of this chapter stem from Kuipers, Van Ees, and Van der Lecq (1997).

a whole is such that a monetary economy can be considered as rather stable. Thus, the instability envisaged in theory is not encountered in the real world.

6.2 Market Stability in a Wicksellian Framework

Both Wicksell and Keynes perceived the possibility of instability as a fundamentally distinctive characteristic of monetary economies. The next section deals with Keynes' treatment of a monetary economy, while this section introduces Iwai's model, which is cast in a Wicksellian framework. Wicksell (1936/1898, pp.120-121) showed how cumulative inflationary and deflationary processes can arise in case the money rate of interest deviates from the natural rate of interest. Iwai (1981) builds upon the Wicksellian line of thought. Iwai's motivation stems from Keynes' General Theory, which countervailed the idea that prices and wages move towards their equilibrium values. In the model Iwai presents, prices are set at monopolistically competitive markets rather than taken at fully competitive markets, and price setters are uninformed about supply and demand in the future while having to make their pricing decisions. By his model, Iwai aims to explain "the evolution of prices, wages, employment, and output for the economy as a whole" by a "method of dynamic analysis which breaks away from the rigid framework of traditional theory that has been preoccupied with describing equilibrium and asserting a natural tendency towards it" (Iwai, 1981, p.xvii).

Iwai shows how the research that models a Walrasian economy without an auctioneer follows from three paradoxes of the neoclassical model. Firstly, a centralized auctioneer is necessary to coordinate decentralized price setting decisions. Secondly, equilibrium trade is guaranteed by forbidding non-equilibrium "false trading" to take place, so that "the market is forced to imitate theory" (*ibid.*, p.8). Thirdly, in the absence of an auctioneer, at least one party must be able to change prices in order to secure an equilibrium; contradicting the assumption of all traders being price takers. These three paradoxes allow Iwai to start from price setting behaviour while leaving out the auctioneer. Further, he distinguishes negotiated price markets, "in which approximately

equal numbers (which may be just one) of buyers and sellers communicate with each other and negotiate prices," from quoted price markets in which "one side of the market quotes prices on a take-it-or-leave-it basis" (*ibid.*, p.9,10). Iwai notes that negotiated price markets form a decreasing fraction of all markets, whereas the fraction of quoted price markets increases. This observation implies that the assumed negotiation process which results in equilibrium outcomes in each market may be less realistic than it was previously believed to be. Unfortunately, Iwai's decision to model only quoted price markets on the basis of this observation has the result that the demand side of the goods market as well as the supply side of the labour market are neglected. Sellers set supply prices at the goods market and employers set wages at the labour market. The only way in which the demand for goods is represented in his model is by the purchasing power of wage earners and the sales revenues of employers. However, this indirect representation does not specify aggregate demand conditions.

Given these qualifications, Iwai asserts that if Walras' law holds, markets for goods need not be in equilibrium as long as disequilibria at some markets can compensate disequilibria at other markets. Then, total demand for goods equals total supply of it, so that the general price level is stable and Say's law holds. From this conclusion, Iwai follows Wicksell by inferring that aggregate demand must become or be expected to become greater than supply in order to raise the general price level. In a barter economy this is not possible. In a monetary economy, this may come about through dishoarding or money creation. Such a rise of the price level may be a cumulative process, which is elegantly modelled by Iwai. In his model of quoted price markets, prices have a signalling as well as an incentive function. They both signal relative scarcities and provide incentives to reveal true preferences by buying or selling transactions. In an economy with incomplete information, prices do reveal incentives, but they only reflect expected relative scarcities instead of realised ones. The cumulative process starts at the moment a Wicksellian disequilibrium occurs, in which a gap at the goods or labour market exists (*ibid.*, p.86). Then, Say's law does not hold, since the market for money needs to accommodate for

disequilibria in the goods or labour market. In such a situation of disequilibrium, the supply of money does not have to be equal to the demand for it (*cf.* Koopmans, 1933, pp.258-259).

In Iwai's construct, Say's law holds exclusive of money (*ibid.*, p.81, fn.2). If the demand for goods exceeded the supply to an extent larger than the demand-to-supply ratio which is normal at that particular market, suppliers in the goods markets would tend to increase their nominal prices. As firms only know their own prices at the beginning of each period, they would then try to raise their prices relative to the general price level in order to restore their normal demand to supply ratio. The problem that emerges lies in the fact that firms try to raise their prices co-temporaneously, because the product market gap affects them all at roughly the same time. The cumulative effect of these individual price increases is a rise in the general price level, an occurrence which none of them anticipated. As such, each firm's intended relative price adjustment turns out to be only a nominal adjustment with no mitigation of the initial gaps in individual supply and demand. The higher nominal prices result in higher nominal income, so that the high demand is maintained. This unintended consequence of price adjustments is not abated if firms adjust their expectations of the price level increase, since the relative price structure and the higher than normal demand-to-supply ratios have remained intact. Therefore, the cumulative process continues, progressing into an accelerated process once suppliers expect the demand-supply gap in the goods market to remain, subsequently causing them to expand their production. As a result, the demand for labour rises, which raises the level of money wages. Analogously to the product market situation, in the labour market, producers all make the same nominal wage setting decisions, so that their wage offers intended to raise relative wages turn out to only raise the general wage level. The higher money wages that result anyway, cause the product market gap to remain. Thus, there emerges a general price and wage spiral. A roughly equivalent process can be described for a situation of cumulative deflation.

Iwai doubts whether the Pigou effect can counteract processes of

cumulative inflation or deflation. The more an economy is credit[2] rather than cash oriented, the more banks accomodate by extending or withdrawing credit lines, so that the real balance effect is diminished and the cumulative processes can continue (Iwai, 1981, p.160). In Iwai's framework, the only way in which either process can be stopped is by creating a nominal anchor, that is, by fixing nominal wages. Remarkably, Iwai does not mention the option of fixing nominal prices (*op.cit.*, p.162). Iwai thus comes to the same conclusion as did Keynes (1936, p.304), by claiming that "contrary to the position of neoclassical economics, we can claim that it is the inflexibility of money wages rather than their flexibility that is stabilizing the monetary economy" (Iwai, 1981, p.162).

The fact that Iwai only mentions nominal wages raises the question as to whether the fixing of nominal wages is the only way in which the economy can be stabilized. Of course, one could as well argue that nominal prices can be fixed as well, but this measure would be as arbitrary as fixing wages and even less realistic. Instead, two other reasons can be given for saying that nominal wages need not be fixed. The one reason is that Iwai's model lacks a demand side mechanism from which stabilizing effects can be expected, while the other reason is that the Pigou, Keynes and Fisher effects are not adequately addressed.

As for the demand side of the goods market, this lacuna in the Iwai model still remains to be filled. The same can be said for its mirror-image, being the supply side of the labour market. In fact, a possible way of introducing a demand side may be found in the modelling of negotiated price markets besides quoted price markets. In spite of his observation that most markets are of a quoted price type, Iwai himself makes a first attempt in this direction by introducing unions in the last chapter of his book. These unions not only have the option of calling a strike, but partake in the negotiation process as well. Though in an earlier stage Iwai already included a variable representing the costs of wage adjustment, so that wages were not adjusted to small labour

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[2] A flexibly coordinated economy tends to be relatively credit oriented (see chapter 5).

market gaps, the introduction of unions provides an underpinning of the existence of a range within which nominal wages remain unchanged. Only large or permanent gaps in the labour market will now induce employers to change nominal wages. However, unions are at the supply side of the labour market. Modelling the negotiation of wages does not provide a model of the demand side at the goods market or the supply side of the labour market. More generally, modelling the way in which prices are determined, either by quotation or by negotiation, may reflect the interaction of supply and demand, but not the factors which determine demand conditions. In other words, in spite of the rather *ad hoc* introduction of unions, the model still calls for completion by the introduction of a full-fledged demand side.

The second criticism of Iwai's presentation contends that the Keynes, Pigou and Fisher effects are neglected. As such, the second criticism also deals with demand side phenomena. Although Iwai briefly discusses the three effects,[3] the dispute which he does not address, is whether his arguments are valid and sufficient in order to conclude that these three effects do not procure stability, nor does their net effect. The impact of this criticism of the Iwai model for the purpose of explaining nominal price rigidity is substantial, because in case the model can be amended in such fashion that nominal wage rigidity is not necessary for stabilizing the economy, Iwai's work cannot serve as support for the thesis that a monetary economy requires money wages to be rigid in order to be stable. In fact, the same lack of arguments for nominal price rigidity would result because of the symmetrical way of modelling the labour and goods markets. However, this does not imply the opposite case often made by neoclassical economists, namely that rigid nominal wages and prices destabilize the economy.

Instead, it seems obvious that an optimal degree of rigidity may exist in between. A formal way of deriving this optimal degree of price rigidity, which then has the character of price stickiness, may not be feasible within the framework of the Iwai model. The reason for this is that Iwai maintains the

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[3] See Iwai (*op.cit.*) sections 3.20 and 5.15.

assumption that prices only react to supply and demand conditions in their particular markets. The demand and supply conditions are partly determined by the former period general price level and by the price setting results in the new period price level. For the purpose of the present book, this argument can be reformulated as follows. In the neoclassical model, price flexibility is necessary for stability of the economy.[4] As opposed to this, in the Iwai model, price rigidity is the only guarantee for stability. In the argument developed in the present study, price stickiness stabilizes the economy. This coordination function of nominal prices discussed in chapter 3 can thus be added to the signalling and incentive functions mentioned by Iwai. Prices also support buyer-seller relations and are part of implicit contracts. These aspects of price setting are important for stabilizing the economy, but can not be translated into cardinal variables required for formalizations as in the Iwai model. Therefore, the idea of optimality with regard to the degree of price stickiness may be meaningless. It may also be far-fetched or irrelevant. The idea of an optimal degree of price stickiness may be too far-fetched in case markets differ, so that every market requires its own degree of stickiness. For instance, the optimal number of price catalogues issued per year can be calculated on the basis of a cost-benefit analysis, with differing outcomes per market. Optimality is also far-fetched in calculating the differing length of wage contracts. It may be irrelevant in case the economy described in the present framework needs not be modelled formally in order to be analysed. For instance, whether or not workers' committees or unions represent employees at the wage negotiation table, may be arbitrary in terms of resulting wage levels, but they do yield different results in terms of coordination and stability. So, the Iwai model is useful for the purpose of explaining nominal price and wage rigidity to the extent that it makes a case for it, but the fixing of nominal wages may be too harsh a measure, and even a destabilizing one, in real economies in which prices and wages have more functions than the ones modelled by Iwai. If wages

[4] Price flexibility is a necessary, but insufficient condition for stability. A supplementary, sufficient condition is gross substitutability. However, gross substitutability is not a necessary supplementary condition in order to achieve stability.

are not fixed but merely sticky, the way in which this stickiness is accomplished needs not take the form of government intervention. Social institutions such as unions also limit wage flexibility, as Iwai indicates at the end of his book (1981, p.243). The same holds for prices. For both wages and prices, conventions, such as discussed in section 6.4 below, can also contribute to a beneficial degree of nominal stickiness. To quote Iwai once again:

> "In consequence, the dynamic evolution of an economy in both the short and long runs can only be understood as a process of complex interactions between the price mechanism of markets and these social institutions, which have their own modes of existence. This, we believe, opens up a new perspective for institutional economics." (Iwai, 1981, p.243).

By stressing that institutions differ in their modes of existence, Iwai indicates that institutions are more than mere limits to price flexibility. However, this conclusion supports the thesis that both phenomena cannot be put on the same unidimensional scale as is required in a model such as Iwai's. Therefore, trying to determine the optimal degree of price flexibility in a monetary economy is both impossible and of little use. Instead, as shall be indicated in the remainder of this chapter, an institutional economics approach to the issue of stability of a monetary economy is more revealing of the actual functioning of real-world economies. This institutional approach, as will be seen, goes well together with ideas by Keynes and Post Keynesians.

6.3 Keynes on money and instability of a monetary economy

In his chapter on the essential properties of interest and money, Keynes explains which properties of money as a medium of exchange may be held responsible for the instability of a monetary exchange economy as opposed to the stability of a barter exchange economy (Keynes, 1936, ch. 17). These properties are "a zero, or at any rate a very small, elasticity of production" of money and "an elasticity of substitution equal, or nearly equal, to zero" of money with respect to other goods (Keynes, 1936, p.230 and p.231,

respectively). Since money is the only asset whose liquidity premium exceeds its carrying costs, the money rate of interest is relatively sticky, at least downward, as compared to the own rates of interest of other assets with a lower liquidity (*op.cit.*, p.229). By implication, money wages are relatively sticky.

On the basis of Keynes's argument, it can be argued that a monetary exchange economy, with contracts denominated in nominal terms, differs from a barter exchange economy in that the essential characteristics of money make it inherently unstable. Inflationary and deflationary tendencies may continue forever, and may even accelerate if destabilising expectations are taken into account. If aggregate demand is less than total income, money can become a "bottomless sink of purchasing power" (Keynes, 1936, p.231), with a high liquidity premium that drives up its value. The rise in the own rate of interest of money is not stopped by substitution effects, since money has "an elasticity of substitution equal, or nearly equal, to zero" (*ibid.*, p.231). Money's relatively high interest rate causes investment to stop at the level at which its rate of return is as high as money's own rate of return (*ibid.*, p.229). In this process, both investment and effective demand are low, and the radius of the circle describing the interaction among flows of income, output and spending gets smaller: the economy is in a recession. In economic downturns the total costs of production are less than the proceeds from sales. As Keynes argued, cutting costs boils down to reducing the income of workers, which has the effect of reducing sales even further (1930, p.130). The decline of profits which results from this situation make investment in capital goods unattractive, so that the economy remains in a depression. Therefore, he concluded that the terms of lending money should be made easier to meet in order to stimulate investment again (*op.cit.*, p.133).

A few other considerations can supplement this Keynesian scenario. Once agents expect prices to decrease, they tend to postpone buying transactions in order to profit from even lower prices, so that the excess supply

remains. In other words, the Pigou-effect may not hold.[5] Besides the argument by Keynes (1930) cited above, only in case prices are low enough to be expected to rise again, a real-balance effect may be triggered. However, firms are reluctant to lower their prices that much, as they are likely to need the sales revenues for repaying their debts, which are denominated in nominal terms. The instability of a monetary economy can persist because Say's law does not provide a countervailing power. Money "is not merely a vehicle of exchange but a vehicle of the vast expansion of the sphere of exchange itself" (Iwai, 1981, p.113). These inherent destabilising tendencies provide a serious threat to the very existence of monetary economies as too large a flexibility of prices hampers the functioning of money as a medium of exchange and unit of account. Calculations, communication, transactions and contracting which all link the present to the future need a stable monetary unit.

In spite of the theoretical possibility of an unstable monetary economy, it can be observed that many monetary economies are stable. In the real world, situations of hyperinflation in developed economies are rare. In western economies they only occurred in periods during which government finances were in total disorder, as for instance during and after wars and revolutions. Hyperdeflations have never occurred, even though prices and wages did fall during the great depression of the 1930's. If it is observed that developed market economies are characterized by relative stability, it is necessary to consider the question as to what stabilising forces may exist which neutralise the inherently destabilising tendencies of a monetary economy pointed out by Wicksell and Keynes. Again, it turns out that it is price and wage stickiness that stabilizes a monetary economy in the sense that they provide anchors to expectations of income flows potentially occurring in a fundamentally uncertain future (*cf.* Keynes, 1936, p.148; 1973, p.124). So, contrary to the Walrasian economy without money, it appears that nominal price rigidity is a

[5] For a clear exposition of the Pigou effect, as well as a comment on its name, see Patinkin (1956, p.21).

fundamental factor causing a monetary economy to remain at a stable level of production and income. Moreover, the existence of sticky prices facilitates the functioning of a unit of account. Thanks to a stable price level, the effort of calculating relative prices can be done by using only money prices (Lerner, 1952, p.191). Conventions and institutions as norms for behaviour play a crucial role in the beneficial effect of price and wage rigidities (Keynes, 1936, p.152). Except in cases of centralized price measures and centralized wage bargaining, conventions and institutions play a role at the level of one or more markets. In this sense, the argument developed here hints at a micro foundation for the stability of a monetary economy, which provides the element missing in the Iwai model. At the same time, the evolution of conventions and institutions can seldom be explained from individually optimizing behaviour, so that a macro foundation of individual behaviour is required as well. To this macro approach, the attention is turned, now.

In chapter 2 it was argued that money is redundant in an Arrow-Debreu type economy. In order to make money essential, the concepts of fundamental uncertainty and historical time are minimum requirements. Historical time implies that different moments or periods of time have different characteristics and are irreversibly related to each other. Past decisions influence the present, so that hysteresis and path-dependency can occur. Fundamental uncertainty, according to Davidson, is caused by non-ergodicity of economic processses (Davidson, 1994, p.90). Roughly put, if the time and space averages of a stochastic process do neither converge nor coincide, then the space or time average cannot be taken as a reliable estimator of the future space average. This is to say that the future cannot be fully known by knowing the past and present. Investors who have to make their decisions have to build upon their expectations. Incorporating these concepts involves an entirely different mode of thinking, since the result is a fundamentally different understanding of a market economy (*cf.* Keynes, 1973, p.369; Hoogduin & Snippe, 1987, p.435).

In writings which were originally intended to be part of the *General*

Theory, but removed afterwards. Keynes distinguished three kinds of economies: a cooperative or real-wage economy, a neutral economy, and an entrepreneur or monetary economy[6] (Rotheim, 1981, p.575). In a real-wage economy, the factors of production receive a part of aggregate output that is in proportion to their contribution to it (Keynes, 1933, p.77). The "marginal utility of output is equal to the marginal disutility of effort" (*ibid.*) so that the two classical postulates hold by assumption (see below in this section). The two postulates can only hold if Say's law holds, that is, if all incomes are spent, so that each factor can receive its share of aggregate output. In a real-wage economy and a neutral economy, this is the case. As long as spending equals output, the two only differ in that the factors are paid in product, or in money, respectively. Keynes denoted the neutral economy in terms of the C-M-C terminology introduced by Marx, which reflects that commodities are the prime orientation of economic actors (Rotheim, 1991). Money is no more than a veil, which does not influence outcomes in real terms (Rotheim, 1981, p.576). Models with commodity money, like the search-theoretic models discussed in chapter 2, can be interpreted as such. In a neutral economy, unemployment only occurs in times of adjustment to changes in the demand for labour across sectors, which compensate each other because all income is spent. The entrepreneur economy is characterized by the possibility that not all income is spent, so that general unemployment may occur. Fluctuations in effective demand may result in part of the money incomes to be kept for some time, so that part of the output is not sold. In terms of Marx' notation, the entrepreneur economy is M-C-M' oriented, which reflects the attitude of entrepreneurs who invest money in order to end up with more of it. As the use of the apostrophy (M') indicates, a surplus value of (M'-M) can be created in a monetary economy, but not in a neutral economy. In an entrepreneur economy, outcomes in terms of money are

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[6] In Keynes (1933, p.78) the latter two economies are called "a neutral entrepreneur economy, or a neutral economy, for short" and a "money-wage or entrepreneur economy," respectively. In the following, the term neutral economy will be use for the second type, while for the third type the terms monetary economy, money wage economy, and entrepreneur economy are intermingled.

a goal *per se*, since it is money wages and profits that move the actors in the economy. Calculations in terms of money not only save the costs of calculating all relative prices (Lerner, 1952), they are most closely linked to the perception of economic outcomes as well. Now that not all income may be spent, some of the labour which could be employed in production may be unprofitable, which results in unemployment. Decisions on starting production processes are based upon expected profits in terms of money (Keynes, 1933, p.78).

For the present purpose of studying the implication of the use of money, the real-wage economy is not relevant, since money is only used in the latter two types of economies. In a neutral economy, money acts as a means of facilitating the exchange process. Trade depends on the calculation of returns in terms of commodities. In an entrepreneur economy, however, money is more than a medium of exchange. It "provides the context of behaviour in the sense that monetary, not commodity, returns act as the motivation of economic behaviour" (Gerrard, 1995, p.453). The store of value function has more impact in an entrepreneur economy than in a neutral economy because in an entrepreneur economy holding money no longer implies future demand for goods, at least not with certainty. It is the store of value that invalidates Say's laws and connects the present to the future, as was argued by Iwai and Keynes, respectively.

A crucial feature of the entrepreneur economy is that labour is paid for in terms of money, which is reflected in Keynes' term money wage economy. The fact that workers receive money enables them not to consume all of their wage income. As a result, aggregate effective demand, expected future profits, investment, and the demand for labour are all diminished in the next period. Workers who have received their wages may decide not to spend all of their wages on goods, that is, they save. By hoarding their money-wages instead of spending them, or at least deferring those purchases, workers try to mitigate the impact of fundamental uncertainty on their own expenditure decisions, but increase the uncertainty other agents face. If consumers do not spend all of their wage income in the present, it does not follow that future consumption will be accordingly higher. It may equally well indicate that their consumption will be

low in the future as well (Keynes, 1936, p. 210). Entrepreneurs do not know if and when these savings will be dishoarded, so they face uncertainty with respect to future expenditures. Therefore, they must decide on how much to invest for future production on the basis of expected profits or expected sales. For lack of anything better, entrepreneurs connect their expected profits to their present income. Investment decisions are based on these sales or profit expectations and result in the future production capacity and an accompanying demand for labour (*cf.* Kregel, 1987, p.531). The (neoclassical) neutral economy, in which decisions are based on realized results differs from the (Keynesian) entrepreneur economy in which decisions are based on expected results (*cf.* Kregel, 1980, p.35). Thus, in an implicit way, the analysis is made dynamic. The time aspect is directly connected with the use of money "For the importance of money essentially flows from its being a link between the present and the future." (Keynes, 1936, p.293). Present expenditure is not determined by, and not even limited by, present income, but determined by expected future income (Kregel, 1980, p.36). In a non-ergodic economy, the forming of such expectations is at least imperfect, if not impossible (*cf.* Hoogduin and Snippe, 1987, pp. 434-436). This line of thought differs from the neoclassical model, in which investment is determined by equalizing the marginal productivity of capital to the real interest rate and labour demand by equalizing the marginal productivity of labour to the real wage level. In a monetary economy, full employment is not secured. Particularly in case an increase of capital is needed in order to secure full employment, the rate of interest can not be assumed to always fall enough to equal the declining marginal productivity of capital (Keynes, 1936, pp.228, 232). By implication, the demand for labour is determined by other factors than the wage rate alone. In the entrepreneur economy, at least in the short run, the demand for labour follows from the expected demand for goods (Malinvaud, 1977, p.3). The demand for goods determines the demand for investment, which results in productive capacity in the next period. The money wages result from bargaining after the demand for labour is determined by the level of investment. The number of jobs and the nominal wages are not determined simultaneously by a confrontation of labour

demand and supply on a 'market for labour', but instead recursively. If effective demand is lacking, then production capacity remains idle, so that the marginal productivity of labour is higher than at full employment. This situation of involuntary unemployment differs from another kind of involuntary unemployment, in which collective bargaining results in too high a level of real wages.[7] All this makes the framework of a market for labour, in which real wages as the price of labour are the only variable, inadequate for analysing a monetary economy (Keynes, 1936, pp. 258-260). In other words, the two "fundamental postulates" of the classical theory of unemployment cannot be said to hold, those being:

> "I. The wage is equal to the marginal product of labour."
>
> "II. The utility of the wage when a given volume of labour is employed is equal to the marginal disutility of that amount of employment." (Keynes, 1936, p.5).

Only in equilibrium does the supply of labour equal demand for it, and is the real wage level such that the marginal product of labour equals the disutility of the marginal employment (*ibid.*, p.6). Otherwise, suppliers of labour remain unemployed (Malinvaud, 1977, p.1). Outside equilibrium, the demand curve and the supply curve of labour given by the postulates I and II above do not interact as in the neoclassical metaphor of a market for labour. An alternative perception can be thought of as follows:

> "Market clearing is not the appropriate metaphor when speaking of employment and output as a whole. Rather, recessions occur, from a Post Keynesian perspective, on account of an implosive concentricity among income, output and spending" (Rotheim, 1997).

The concentric model suggested here represents the interconnectedness in an economy more explicitly than does the better known Walrasian framework of

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[7] Gerrard (1995, p.456) calls the latter one a case of voluntary unemployment. However, from the point of view of the individual, resignation seems 'even more voluntary' than being unemployed because of too high wages. Keynes himself seems to combine the two cases of resignation and too high wages in the situation of the "refusal or inability of a unit of labour [...] to accept a reward corresponding to the value of the product attributable to its marginal productivity" (Keynes, 1936, p.6).

markets, because quantities of goods and labour demand influence each other directly instead of influencing each other only via price and substitution effects (*cf.* Malinvaud, 1977). To sum up, in an entrepreneur or money-wage economy, two features are of crucial importance: Say's law does not hold and the demand for labour is separated from the supply of it in such way that the concept of an aggregate market for labour loses its meaning (Gerrard, 1995, p.453; Rotheim, 1996, p.4). However, in the following section, the metaphor of a market for labour remains in use in the abstract connotation of the virtual location where wage contracts are settled.

A monetary economy calls for a different mode of analysis as compared to the neutral economy. No longer can the economic outcome be derived from optimising allocation decisions, but the actual motivations and patterns of behaviour need to be taken into account (Gerrard, 1995, p.453). This inference resembles that by Iwai, in his case for an institutional approach to the modelling of price setting behaviour. It also conforms the argument that real world conventions and institutions as ways of coping with uncertainty result in the use of money and nominal price setting behaviour. Therefore, the Keynesian monetary economy, inclusive of the coordination problems as an integral part of it, is the most appropriate framework of analysis here. At the labour market and at goods markets, many conventions and institutions contribute to stabilizing the economy.

6.4 Coordination at the goods and labour markets

In a monetary economy money can fulfil its functions of medium of exchange, unit of account and store of value best if its value in terms of goods is as stable as possible. Then, the uncertainty which is inherent in a monetary economy is not further enlarged by uncertainty concerning the unit which forms the basis of the economic calculations agents make. From a theoretical point of view, it seems logical to infer that individual agents will contribute to a stable value of money by keeping their money prices as rigid as possible. However, the individual and the collective interests do not necessarily coincide. For, whereas

a stable price level is favourable for all individuals, for every individual it may be advantageous to maintain maximal individual price flexibility (Garretsen, 1992, pp.174-175). This paradox is one of the main coordination problems of monetary economies. One way of solving this coordination problem is the creation of an institution which is given the task to maintain price stability. A solution of this kind can be found in Western economies where today's central banks have the statutory obligation to maintain aggregate price level stability. The mere establishment of an institution is, however, not a sufficient solution because of theoretical as well as policy reasons. First, it is very doubtful that deflationary price movements can be combatted effectively by loosening the monetary conditions, because such policy may provide insufficient incentives to stimulate aggregate demand. Secondly, in terms of lost output, it may be costly for the monetary authorities to fight a strong and structural inflationary spiral in an economy. There is little evidence of such a combat as a permanent phenomenon, not even in the (moderate) inflationary decades after World War II. Thirdly, during the present century, the increased importance of central banks went along with unprecedented rates of inflation. Hence, although central banks have often not been able to guarantee a stable value of money, this has not affected the degree of public confidence generally attached to central banks. Presumably, this confidence is best understood as a manifestation of external social beliefs as to how a monetary economy works, rather than as an accurate public understanding of the fundamental characteristics of a monetary economy (see chapter 5 and Van Ees and Garretsen, 1995, pp.285-286). Therefore, other (institutional) solutions to the coordination problem are likely to exist. The present section discusses such solutions which exist in the goods markets and the labour market. Some of the articles cited below were introduced in earlier chapters, in particular chapter 3. Here, their findings are interpreted in terms of the framework developed in chapters 4 and 5.

Goods markets: nominal prices

One of the causes of the observed stability of western, decentralised economies may be found in the structure of their commodity markets. Most markets are

characterised by the market form oligopoly or monopolistic competition and the accompanying existence of market barriers. Only few markets can be considered perfectly competitive, with free entry and exit and being cleared by an auctioneer. In fact, the latter kind of markets can only be observed in the sectors of raw materials and finance. The trade of industrial goods and services occurs in the former kind of markets. The occurrence of monopolistic and oligopolistic price setting goes together with the incentive of entrepreneurs to compete by means of other instruments than prices, such as quality, service, speed of delivery, special relations with the client, and fashion (Blinder, 1991; Carlton, 1989). These non-price instruments contribute to coordination on these markets as well (Scherer, 1980, Ch. 6). As opposed to the perfectly competitive markets, trade and competition on these markets are not anonymous but involve personal relations with other market participants, on the same as well as on the opposite side of the markets. The latter criterion makes Okun distinguish auction markets in the former from customer markets in the latter case (Okun, 1981, pp. 134 ff.). As was discussed in chapter 3, pricing behaviour in customer markets is not only determined by cost-benefit calculations, but by other motives as well, such as signalling credibility and loyalty to the seller-customer relationship.

The creation of monopolistic markets and the erection of barriers to entry can firstly be explained from the motive to realise short-run monopoly profits. However, a more fundamental motive may be the need to secure the future viability of the enterprise by reducing the uncertainty surrounding the company. This uncertainty is particularly substantial once the future position of the company not only depends on its own efforts and strategies but on the strategic behaviour of clients and competitors as well. In particular, in case of irreversible decisions like investment decisions that bind the company for a long time, the company may attempt to reduce the uncertainty which these decisions are subject to by engaging in long-term contracts with buyers and suppliers, by creating networks with buyers, suppliers and sub-contractors, by mergers and acquisitions, by cartel agreements, and by creating implicit contracts. Both explicit and implicit contracts have the effect of stabilizing prices

or making price changes predictable. Money-denominated contracts require a system of sticky wages and prices, because only then it can be advantageous to engage in long-term commitments, such as investment decisions (Davidson, 1980, p.300). Implicit contracts of retailers with consumers contribute to maintaining a trust relationship with consumers. An example of such an implicit contract is the intention only to increase prices in case of cost increases (Okun, 1981). Here, the notion of fairness plays a role, as was argued in chapter 5. Fairness and reputation reflect a public manifestation of beliefs that can only partly be related to economic fundamentals. Implicit contracts between competitors in an oligopolistic market may consist of the tacit agreement not to pursue price competition (Cyert and March, 1963, p.120). Many firms do not profit from price wars and prefer to reduce this source of uncertainty and losses by fixing their prices for longer periods of time. Implicit and explicit contracts both have characteristics of conventions and institutions, though in different degrees. In situations of uncertainty, both sellers and buyers profit from the building up of a seller's reputation. The seller profits, because a good reputation brings repeated business (Okun, 1981, p.140). The buyers profit, because a solid reputation requires less monitoring and searching effort. Buyers trust their seller because they assume a common standard for 'fair' behaviour. This standard then becomes a convention. The more standardized the behaviour, the more easily 'unfair' behaviour can be detected (Hargreaves Heap, 1992, p.125). Rules of fairness can become institutionalized (Okun, 1981, p.153). Examples of such rules are broker fees and consultancy tariffs. All this leaves open the possibility that a pricing schedule may be regarded as 'fair' simply because people have become used to it. The reference price can become customary even though it may be considered 'unjust' when scrutinized (Kahneman *et al*, 1986, p.730). As argued in chapter 3 already, only nominal prices can become reference prices, as otherwise they cannot be generally recognized as such. Thus, customs with respect to price setting may determine expectations which become self-enforcing norms for behaviour. In this way common practices, however arbitrary, can become conventions.

Coordination problems of the mixed motive type are present in

oligopoly markets in which interdependent decisions have to be made on the timing of sales, the type of after-sales service, reasons for price increases that are considered legitimate, the timing of issuing new price lists, the closing times of shops, *et cetera* (see *e.g.* Kahneman, Knetsch and Thaler, 1986; Blinder, 1991; and Leibenstein, 1984). These examples contain a conflict element to the extent that they are instruments for competition. The same holds for coordinating the timing of price changes. For example, the oligopolist who first starts with a sale may attract most customers. They are also subject to coordination, because all oligopolists are best off with synchronized behaviour. As long as there is no 'objective' criterion for deciding upon these matters, agreement must be reached on a focal point. This agreement cannot be reached by communication, because anti-cartel legislation forbids so, so the focal point must emerge from the context in which the oligopolists operate (Hargreaves Heap, 1992, p.122). Then, the focal point needs to be 'obvious,' prominent or otherwise unique in order to serve as an anchor for mutual expectations of the oligopolists. If the coordination norm is established, it provides information on how to behave in the oligopolistic market. Still, price setting agreements in an oligopoly, however tacitly made, may be binding in situations of credible threats of price wars. Then, a binding agreement exists, and the price setting game is cooperative. Depending upon circumstances and the way of coordination, nominal prices may remain unchanged for long periods of time. Both the relatively long period in which nominal prices then remain unchanged and the fact that they are expressed in terms of the commonly used money contribute to their functioning as a focal point. If sellers experience a decrease in demand, they may have difficulties finding out whether it is a general decrease in demand or only specific to their firm. In the latter case, they may be tempted to lower their prices in order to attract customers, whereas in the former case, this would not help, as is described by the Iwai model discussed in section 6.2. In order to prevent this unintended effect to materialize, sellers can synchronize their price changes by an implicit or explicit agreement. If some moment in time, for instance the beginning of the product's season, becomes the conventional moment to change prizes, changes in sales volume can be interpreted

unambiguously and a price war will not occur. Conventions with regard to the issuing of new price catalogues are a clear example. In his article on retail catalogues, Kashyap (1995, p.252) explicitly mentions conventions which make retailers issue new catalogues twice a year. Since, on average, prices change only once a year or less, Kashyap concludes that retailers only change price tags every other time they have an opportunity to do so. In the clothing sector, price changes are closely ruled by the seasons. Just before the new collections arrive, a sale is held. Sales are necessary because of the inventory costs as well as the high sensitivity to fashion which makes clothes very hard to sell in the next year. For the industry as a whole, synchronizing the sale is clearly profitable. However, the individual seller has an incentive to start a little earlier than his competitors. Therefore, the timing of sales are often institutionalized. Regulation prohibits free-riding in this prisoner's dilemma game type of situation. For instance, in the Netherlands, the abolition of this regulation is seen as one of the factors that caused the decline of profits in the clothing sector. It resulted in sales being held virtually during the whole year and severe undercutting practices. The call for re-regulation has been heard already (Schreurs, 1995). An institutionalization of the timing of sales could solve the prisoners' dilemma type of coordination problem in this sector.

Implicit contracts also serve to solve coordination problems at goods markets. At 'customer markets,' agents shop around for favourable offers by suppliers until they conjecture having enough information to decide on a purchase (Okun, 1981). Their shopping behaviour aims at minimizing the risk of missing a relatively favourable offer, with time spent on shopping as a constraint. The supplying firm, at the other hand, has a stake in a long-term relationship with its customers and will put effort in setting up such a relationship (Clower and Howitt, 1994, p.9). Reputation building contains an implicit promise by a supplier to behave in conformity to the reputation, *e.g.* charging low prices, and an implicit promise by customers to buy at that particular shop. In this sense, the theory of implicit contracts as developed by Okun (Pechman, 1983) exemplifies a mixed motive problem. The coordination element is given by the mutual benefits of being committed to the relationship

and the lack of an external enforcing authority. A conflict element is present because both parties are tempted to profit from defecting.[8] The implicit contract, being the norm for behaviour that results, is accordingly hybrid.

The influence of long-term relationships between buyers and sellers on the rigidity of prices has been subject of many studies. A conventional opinion is formulated by Stigler and Kindahl (1970, p.6), who argue that contracts are stated in terms of the expected average price during the contract period. Interestingly, they add that most contracts allow for renegotiation once the spot price moves outside a specified range around the contract price. Such type of *Ss*-rule may thus contribute to nominal price rigidity. Carlton, however, opposes to this view. Firstly, he contends that many contracts do not even specify prices and quantities (1989, p.920). Secondly, he argues that particularly in long-term contracts, prices are not fixed, because buyer and seller know each other well enough to agree on price adjustments (1991, p.124). In long-term relationships the trust is not endangered by frequent small price adjustments. Opposed to this are the short-term relationships, which are more anonymous. Here, adjusting prices invokes the costs of again building up trust, so price adjustments are infrequent and relatively large (*cf.* menu costs). Carlton supports his argument by empirical research (1991). This argument by Carlton undermines the idea of a band around contract prices that contributes to price rigidity. So far, the issue seems to have remained unsettled.

The existence of long-term contracts and the emphasis on non-price instruments in competition as a means to reduce uncertainty or to increase the individual confidence in economic activities not only imply that prices will react to shocks rather slowly and moderately, but also that demand growth will be met by an expansion of capacity and not by price increases. Moreover, new market entrants may be expected to follow the existing rules of competition between incumbents, while new products resulting from innovation efforts, as

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[8] If both players succeed in building up a credible reputation of playing a tit-for-tat strategy, the situation can be interpreted as a repeated Prisoners' dilemma game (see section 4.2). Besides, the reader may also recall that Prisoners' dilemma games contain an element of coordination.

far as they can be perceived as substitutes for existing products, may be expected to be supplied at prices in close proximity to the prices of existing products. So, the general picture is one of quantity adjustments and fairly stable prices. Obviously the gain in (aggregate) price stability is earned at the expense of a loss of (aggregate) efficiency. However, the relevance of this observation is rather small. Paretian welfare theorems are of little relevance in a monetary economy, in which the need for stability has a relevance of its own. In other words, the benchmark of the competitive general equilibrium has hardly any insights to offer for the actual working of the economy as a whole.[9]

Conventions and institutions influence the decisions of two groups of agents, those being the workers/consumers and the employers/investors.[10] Both groups are subject to norms for behaviour and profit from the existence of these norms, among other reasons, because they enable them to better predict the behaviour of others. Firstly, consumers/workers have information concerning the terms of their employment and the prices at goods markets, so that they can make decisions they could not have made with equal foundation in case of fundamental uncertainty. The uncertainty is reduced by norms which function as an anchor for expectations. Secondly, employers/investors are able to make relatively accurate predictions of demand and their competitor's behaviour because of price setting norms and can reliably make their investment decisions contingent on these predictions. New norms may evolve in case agents deviate from conventional behaviour or start a public discussion on changing an institution. An example of the first case is a change in the after sales service offered by a particular firm, such as delivering the purchases at home *e.g.* as a way of attracting old-aged customers. As the example illustrates, a convention can change because of changing circumstances, like an ageing population. An example of a public discussion on changing an institution is the

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[9] In this respect, one may wonder why a theory that does not fit the facts still remains the benchmark theory (*cf.* Diamond, 1994, p.54, fn.2).

[10] The government can be left out, because this institution can be considered endogenous to the institution creation processes which evolve from the coordination problems faced by the two groups (see also chapter 4).

topic of closing times of shops. Again, changing circumstances, such as the increased number of working couples and singles, can cause institutions to change. Institutions can change at two levels, namely the level of the decision to coordinate and the level of the specific measures taken to coordinate. In the example, the hours at which shops are opened may change or the regulation of the opening hours of shops may change. Thanks to the institution, customers can be prevented from coming to shops in vain, while shopkeepers are prevented from sitting idle.

In general, institutions may enable an economy to reach a coordinated outcome. Both workers/consumers and employers/investors are better able to decide on their consumption and investment plans, respectively, so that the demand for a store of value is lower than in the non-coordinated outcome. Only insofar as norms are lacking or, for whatever reason, are inadequate predictors of behaviour, uncertainty remains and so does the demand for a store of value.[11] Then, the buffer stock approach to money, discussed in chapter 2, suggests that agents hold a store of value in order to postpone decisions. These decisions can be either selling and buying decisions or decisions to change the prices that make agents willing to do so. In both cases, quantity adjustments result, such as the building up of inventories by producers who face a lack of demand or buyers who have a need remained unsatisfied because the selling prices are considered prohibitively high. In other words, the argument which leads to the conclusion that demand and supply shocks leave prices unaltered is based on the tacit assumption that the economy contains sufficient slack to absorb these shocks. This slack may take the form of stocks, spare capacity and unemployment. If this assumption does not hold true, prices may not be expected to remain stable in case of positive demand shocks. However, if the argument that entrepreneurs prefer non-price competition above price competition holds, then it follows compellingly that the entrepreneurs maintain sufficient spare capacity in order to be able to follow their preferred competitive

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[11] Cf. Keynes (1973, p.116): "... our desire to hold money as a store of wealth is a barometer of the degree of our distrust in our own calculations and conventions concerning the future."

strategy. By this line of reasoning, a rationale for what is usually called X-inefficiency, may be given. Some types of production processes are better suitable for producing on stock than others are. It may be interesting to find out whether price rigidities occur in these very sectors (*cf.* Carlton, 1989, p.941). The same may hold for firms that face low inventory costs and may run more risks of being rationed (Goodhart, 1989, p.19). These firms may also be able to maintain spare capacity in order to meet increased demand at their posted price. Still, it is less clear whether entrepreneurs in a decentralised economy are able to maintain sufficient slack with regard to labour as well. At the labour market, quantity adjustments are more difficult to conceptualize, because, apart from hidden unemployment, labour cannot be stored. Then, rationing of the supply side takes the form of unemployment which cannot be cleared against high employment in another period. To some extent, the same holds for services, whose production and consumption take place at the same moment, by definition. The lack of the possibility to store services makes coordination relevant. As modern economies tend to have a large and growing services sector, the issue of coordination of supply and demand for services becomes increasingly important.

The labour market: nominal wages

As was discussed in section 6.3, Keynes argued that the downward limit to the money rate of interest, which follows from the liquidity of money, allows money wages to be sticky. Sticky money wages enable producers to commit themselves to investment and production and limits goods price changes (Rotheim, 1993, p.203). The assumption that things will remain unchanged can be seen as a convention itself. The expectation that in the short-term future things will not change very much, enables investors to capture large periods by splitting them up in smaller ones and thereby cope with fundamental uncertainty (Keynes, 1936, pp.152-153). Even though one knows better than that, as long as uncertainty concerning the future is too large to form adequate expectations, following this convention may be 'the sensible thing to do.' Starting from Keynes' idea that money wages result from wage bargains and

therefore may be fixed in nominal terms, Bliss developed a game theoretic model of a wage-setting process (Bliss, 1992).

Procedural rationality provides a way of coping with incomplete information, because rules for behaviour can support a desirable coordination outcome, as was described in chapter four. Such norms are seen in the labour market, where employers and workers compare wages across firms in their industry and use this information as a reference wage. For instance, they may calculate the average wage and consider this as a point of reference. Then, the reference wage becomes a focal point. If both employers and workers consider it reasonable to base their wage offer and wage demand, respectively, on such a reference wage, this 'implicit contract' functions as a convention. Conventional behaviour may easily lead to inertia, and may even more do so if the reference wage is based on information from past periods (Okun, 1981, p.95). Sometimes reference wages, or past period wage schemes, provide a useful norm, because they reduce uncertainty with respect to contract renegotiations, so that employers and workers will invest more in their contract relationship.

Institutions which facilitate consultation are important for coordinating the wage bargaining process. In many sectors, the timing of wage changes has become a convention. Coordination of the timing of wages changes is made possible by centralized wage bargaining. The advantages of some degree of centralization of the wage negotiations are twofold.

First, centralizing the negotiations about wage changes mitigates the hold-up problem, by which employers tend to underinvest in the training of the employee, while the latter tends to underinvest in his productivity. For instance, the employee lacks incentives to move to the neighbourhood of the firm s/he works for (Teulings, 1995). Both employers and employees are more willing to invest in their labour relationship if they know that the other party will not be able to renegotiate for some period of time. Reference wages and rules of thumb, like indexation with the consumer price index, stabilize expectations with regard to the division of the surplus (Teulings, 1995). By the institution of a long-term wage contract, either centralized or decentralized,

both parties can bind each other to the relationship. The explicit long-term contract and the mutual trust ('implicit contract') reinforce each other (Okun, 1981). Long-term wage agreements are often institutionalized by their applicability to a whole sector, which can be helpful in case training is organized collectively. The negotiating parties can build other decisions upon this knowledge: the labour agreements become an anchor for their expectations concerning the near future. For example, labour contracts enable workers to purchase houses and obtain loans. The hold-up problem also relates to the timing convention, because the chances of breaking up the individual labour contract may be lower during the time the collective agreement holds than at the time of renewing it. The institute of a collective long-term wage agreement is facilitated by the trust in the other parties' cooperative behaviour, so that the contract can function as a way of structuring behaviour. After a discussion of several empirical studies on unemployment Henley and Tsakalatos also tentatively conclude that "in more corporatist economies wage-setting is more responsive to external economic conditions" (1993, p.79). The beneficial effect of union-coverage on wage moderation is statistically supported for the Netherlands (Van Praag and Hop, 1995), but still remains disputed. Besides the institution of centralized wage bargaining, the labour market convention of timing of these negotiations reduces uncertainty. With regard to decentralized wage bargaining, collective labour agreements are often renewed with fixed periodicity. Strictly speaking, the hold-up argument does not underpin the use of nominal wage agreements. However, as the hold-up problem follows from the same characteristics of an economy as those which make the use of money meaningful, namely uncertainty and historical time, the centralized wage bargaining which contributes to solving the hold-up problem can be interpreted as inherent to a monetary economy.

Second, synchronizing wage changes makes the determination of the wage level a decision to be made by employers and employees together. Insofar as the interests of both groups are opposite, consultation and deciding together may result in a better outcome. In game theoretic terms, the Prisoner's dilemma is solved by selecting the cooperative outcome (Hargreaves Heap, 1994, pp. 43-

44). In many European countries, cooperative outcomes are achieved during economic downturns, because of consensus about the order of wage measures. The opposition of interests, which is common to such a Prisoners' dilemma situations, is solved by cooperative institutions instead of government regulations. In Switzerland, for instance, in cases of negative demand shocks, wages and profits are moderated first, then work-hours are reduced in order to share the work, and only then layoffs occur as a means of last resort (Solow, 1990, p.20). According to Solow, this consensus follows from a common recognition of 'fairness' as constraints on behaviour (*ibid.*, p.23). Convictions concerning fairness differ among countries, however. For instance, in the Netherlands, equal wages for equal work across firms used to be considered fair. Recently, performance related payments have gradually become accepted as well. In Switzerland, profitable firms pay higher wages than less profitable firms to equivalent workers (Solow, 1990, p.20; see also Berndsen, 1993, p.983). The Swiss policy can be interpreted from the dual-entitlement thesis by Kahneman *et al.* (1986), which was discussed in chapter 3. Moreover, Solow sees the Swiss evidence as support to his view that wages and jobs are different from other prices and quantities, because of the emotional impact they have on peoples' lives (Solow, 1990, p.22). Wages differ from other prices in that fairness and social status are more directly involved. Solow describes Switzerland as being a stable combination of a free-market and a regulated economy. In the framework of chapter 5, it can be described as a flexibly coordinated or network economy. Other economies resemble the case of Switzerland in many respects (*ibid.*, p.25). An example of a pricing schedule that is considered fair because it is conventional may be the system of wage scales. Besides the initial wage increase, which is agreed upon by centralized bargaining, wages scales determine the periodical wage increases. Above these two, individual characteristics, such as performance rates, may lead to incidental wage increases. Only this third part of wage negotiations is subject to the hold-up problem (Teulings, 1996, pp.21-23). For civil servants, the first two kinds of wage increases occurred more often than the third one. Because of that, wage changes depended on the level of education, years of experience and years of

being under contract rather than being adjusted for specific skills and talents. Putting wages in such a rigid scheme prevents resent and thereby provides social stability, though it may lack incentives to perform efficiently.

Centralized wage bargaining contributes to solving the macroeconomic coordination problem involved in wage setting: it can prevent nominal wages from being set very high, and thereby limit involuntary unemployment by means of the following mechanisms. Centralized wage bargaining internalizes the externalities involved in nominal wage setting. A money wage increase of a small fraction of the workers can be passed on to others via the relative prices, since such an increase raises production costs, whereas a higher money wage for all workers may raise the price level. Centralized wage bargainers may realize this and accept lower money wages as compared to free-riding individuals. However, unions may also act as free-riders at the expense of the unemployed, thus causing an insider-outsider situation (Bruno and Sachs, 1985, pp.189-190). Theoretically, in cases of demand shocks, adjustment of nominal wages is easier, because centralised wage setting results in a cooperative outcome of the Prisoner's Dilemma type of coordination problem involved (Hargreaves Heap, 1994, pp.43-44). Strictly speaking, in the PD-game, the cooperative outcome might also be reached in a decentralized setting if both players, that is, the firm and the union, realize that the game will be repeated endlessly so that the Folk Theorem holds. However, this observation does not explain how it came about that the negotiating parties perceive the game as such. Some form of implicit coordination that is inherent in corporatist societies may provide the missing link, such as intra-industry coordination at the employers' side (Henley and Tsakalatos, 1993, p.70). In case of decentralized wage negotiations, real wage increases in some of the sectors can be passed on to other sectors by raising output prices. However, in case of centralized bargaining, demands for real wage increases can only result in nominal wage increases, because higher money wages for all workers result in higher output prices for all workers (Layard *et al.*, 1991, pp.132-133). At the other side of the spectrum, individual labour contracts diminish wage demands because of strong competition among workers. The relationship between the centralization

of wage bargaining and unemployment can be modelled as hump-shaped. Calmfors and Driffil, who did so, concluded that an intermediate level of coordination is least efficient. Unfortunately, they neglect informational assumptions which are inherent to the wage bargaining situation (Teulings, 1997, p.660). The authors added that the 'fiscal externality' is internalized as well, because centralized wage bargainers realize that higher wages result in higher unemployment which raises taxes in order to pay unemployment benefits (Henley and Tsakalatos, 1993, pp. 52-60). However, the results of their study has been disputed by others. For instance, the assumed orientation of unions towards maximizing wages may neglect their social aspiration (Van den Toren, 1997, p.146). As a besides, it can be noted that in this way the institution of unemployment benefits influences the working of the institution of centralized wage bargaining. Henley and Tsakalatos (*ibid.*, p.73) illustrate empirically that an in-between degree of centralization of wage bargaining at the industry level results in highest nominal wages as well as unemployment. Berndsen subscribes to this view, though he adds that the outcome of wage negotiations at both a central and a decentral level together, may not be very detrimental to macroeconomic outcomes in case the labour unions take unemployment considerations into account (Berndsen, 1993, p.982). Another way of internalizing the externalities of high money wages is by setting a central wage norm that is enforced by sanctions like higher firm taxes. According to Van Rompuy, this institution contributes to what he calls a "macroeconomic responsiblelisation" (Van Rompuy, 1996). The impact of the negative efficiency effects of a central wage norm on international competitiveness can be compensated for by profit sharing schemes for employees at the firm level. An intertemporal coordination problem is solved as well by centralized wage setting. An implicit or explicit deal can be made in which workers refrain from demanding high wages now, so that firms are able to make profits that can be re-invested, while (capitalist) employers commit themselves to re-investing these profits instead of paying them out as dividends. The latter are tempted to do so, because at the time they face their choice, the profits have been made already. In general, institutions can enforce

the implicit contracts which aim to overcome the time inconsistency problem involved in long-term investments. Eichengreen (1994, §2) describes the institutions that were created in post-war Western Europe as ways to solve this coordination problem. He shows that post-war institutions have contributed to wage moderation which facilitated the large scale investments that can be seen as proximate sources of the high economic growth in post-war Europe. These institutions must make workers willing to be first-movers and make capitalists stick to their commitment. Most of them are based on monitoring both parties and making shirking widely known. As such they may be equally effective but more efficient than the fiscal measures suggested by Van Rompuy which were mentioned above. Other institutions increase workers' participation in management decisions and thus increase the awareness of workers as well as employers of their common stakes in the firm's success. Government subsidy programs and tax holidays can enforce commitment by the threat of losing them in case of shirking. To sum up, both theoretical arguments and empirical investigation support the thesis that labour market institutions contribute to wage level stability.

6.5 Conclusion: stability of a monetary economy

Now that an assessment of conventions and institutions in nominal wage and price setting behaviour has been made, the impact of such norms for behaviour on the economy as a whole are taken into consideration. By now, it can be argued that the way individuals cope with uncertainty contributes to stability of a monetary economy as a whole. Due to conventions and institutions, which may evolve even without the explicit task of pursuing stabilization, individuals can better predict each other's behaviour and therefore make better decisions in case complete information is lacking (*cf.* Heiner, 1983). Examples of such conventions and institutions are implicit and explicit contracts and adjusting quantities so that prices can be kept unchanged for a particular period of time. The use of money helps making decisions in situations of fundamental uncertainty. It contributes to predictable behaviour by creating the ability to

absorb shocks by adjusting buffer stocks of money rather than quantities of commodities.

As the conventions and institutions mentioned above result in prices and wages expressed in terms of money, which can be seen as a convention itself, these norms for behaviour are connected with the role of money and the monetary institutions that go along with it. The stability of a monetary economy, insofar as it is sustained by price and wage setting norms, both causes and hinges upon price level stability. Here, the mutual dependency of top-down institutions and bottom-up conventions and institutions comes in. The stability of the value of money is of such importance, that a societal need is felt for securing this stable money price. Even if all agents were aware of this need, they could only achieve a situation of money value stability collectively. However, it is more likely that not all agents are both aware of this need and willing to forfeit their individual gains from price flexibility. If they were, they could solve the coordination problem by abstaining from the efficiency gains price flexibility would bring them in order to contribute to the benefits of price level stability of the economy as a whole. Rather, it is more likely that individuals show free-riding behaviour, so that the externalities of doing so need to be internalized by maintaining a central bank, being an institution that, in present times, has the aim of securing price level stability. As, by our definition, institutions are accompanied by a sanction mechanism in order to preclude free-riding, a central bank also needs such instruments. For example, it is backed by a law against counterfeiting and, in many countries, has a right to monitor private banks. Both measures, as well as other instruments of monetary policy, enable the central bank to control the money supply or, at least, to maintain a reputation of being able to do so. The official proclamation of a 'basic' rate of interest by the central bank serves as an anchor for expectations concerning other interest rates, such as the interest on mortgages. By giving the central bank the authority to maintain price level stability, the economy provides itself with norms which contribute to price level stability even though not all members of the economy are aware or convinced of the benefits of this top-down institution, for instance because they lack knowledge

of economic mechanisms. Moreover, the institution of a central bank can acquire such reputation that it becomes an anchor for beliefs itself, so that agents who, because of uncertainty, hold a store of value, feel safe to do so because they trust the central bank that backs the value of the money used as such. Further, a democratically chosen government which sets legislation in such way as to make the central bank committed to its price level strategies, can be seen as an institution that ensures the good behaviour of the top-down institution of the central bank (*cf.* Goodhart, 1994, p.110). Because of both arguments, the trust placed in central banks may thus not come entirely 'out-of-the-blue' and economic models which neglect the trust aspect of institutions, or implicitly take it as given, are incomplete tools for analysing a monetary economy. Opposed to this, Keynesian thinking disentangles the quantity of money and its possible inflationary effects from the value of money that stems from its liquidity premium. In this line of thought, price level stability, together with appropriate contract legislation, enables agents to make contracts, reduce uncertainty and bridge time periods (*cf.* Berndsen, 1993; Davidson, 1994, pp.99-100).

All this is to underpin the thesis that top-down coordination, as by the institution of a central bank, is complementary to bottom-up coordination at the labour and goods markets. Both coordination norms on their own are insufficient for securing price level stability. A central bank cannot stimulate an economy just by enlarging the money supply and has a hard time combatting persistent inflation if it is not complemented by the bottom-up institutions which enforce its policy measures. The other way around also holds: firms and individuals are unwilling to make long-term decisions and arrange contracts if they cannot trust the central bank to maintain a stable value of money, that is, price level stability. Further, centralized wage bargaining secures the solution of many coordination problems individuals cannot solve alone. The complementarity of both levels of coordination not only suggests the incompleteness of both constituent parts, but also their mutual beneficial effects: they reinforce each other in their contribution to a stable economy (*cf.*

Buchanan, 1988, p.342).

Although a monetary decentralised economy is potentially unstable, in the sense that cumulative inflationary and deflationary processes cannot be excluded, the above arguments support the observation that it is actually rather stable. The fundamental reason is the same as the reason behind the existence of a monetary economy: the aim to reduce uncertainty of the environment in which the economic agents have to perform their activity. The use of a medium of exchange makes it possible to search for satisfactory trade opportunities and to postpone trade until these opportunities have been obtained. By applying implicit and explicit contracts and by using non-price instead of price instruments to improve and to maintain suppliers' present and future competitive position, shocks may be absorbed by quantity adjustments rather than by price adjustments. A necessary condition for quantity adjustments to precede price adjustments is the existence of sufficient slack in the economy in the form of stocks, spare capacity and unemployment. Hence, the existence of uncertainty with respect to present and future trade opportunities makes money and price stability be two sides of the same coin: both tend to reduce this uncertainty. Both tend to reinforce each other in effectuating this reduction of uncertainty and thus contribute to the stability of a monetary economy. Money as a store of value may enlarge the possibilities to avoid price adjustments and act as a buffer stock in the same way as commodity stocks and spare capacity do. Stable prices diminish the risk of keeping one's wealth in the most liquid form of money and, by this, add to the possibilities to absorb demand and supply shocks by means of buffer stock adjustments. Finally, a stable value of money makes people expect stable money prices in the future and by this contribute to formulating future implicit and explicit contracts in money prices, that is without indexation clauses, which in turn reinforces the tendency to price stability. Insofar as money can be regarded as an institution, price stability may, under these circumstances, be considered a convention. The demand for money as a store of value is diminished by the uncertainty reducing effects of conventions and institutions which enable economic agents to better coordinate their decisions, so that the economy reaches a coordinated and stable outcome.

7 The Monetary Economy: Leaving Behind the Closed System

7.1 Closed System Economics

Mainstream economics, which is either derived from general equilibrium theory or is oriented towards it by using the general equilibrium framework as a benchmark, is a closed system approach. A *closed* system is characterized by the limited and constant numbers of variables or actors that it contains. All relevant information, such as the number of parameters and the set of preferences and constraints, is known to the agents and to the modeller. A closed system may or may not exchange information with its surroundings. If it does not, it is called an *isolated* system (Brooks and Wiley, 1988, p.55). Thus, isolated systems can be seen as a subset of closed systems. Time is a-historical, which makes it irrelevant as an explanatory factor. The number of factors taken into consideration is limited, so that artificial boundaries are set around the economic phenomena which are modelled. These artificial boundaries distinguish exogenous variables from endogenous ones. Exogenous variables are determined outside the domain of the model.

In economics, a model which consists of only endogenous variables is called a closed model, whereas a model in which exogenous variables are included in order to solve it, is called an open model. The term open model reflects the idea that the model would be indeterminate without information from outside, which is added by including exogenous variables. In the terminology introduced above, both closed and open economic models are examples of a closed system approach, because the number of variables is limited and known. Closed models in economics are examples of isolated systems, while open models are examples of closed systems. The domains of the models are limited and artificial boundaries separate the inside from the outside of the models.

In contrast, an *open* system is characterized by an unknown number or

infinity of variables which interact in ways that may not be completely known by the modeller, let alone the agents (*cf.* Sargent, 1993, pp.4, 167-168). In terms of economic theorizing, an open system approach is characterized by indeterminacy, fundamental uncertainty, irreversibility, or a combination of those. As in chapter 2 these aspects were shown to feature the monetary economy, here, the argument is made that a monetary economy calls for an open system approach. Moreover, in section 7.3 it will be argued that the outcome of a particular open system analysis in chemistry resembles the outcome of the present analysis of a monetary economy as discussed in the previous chapters, particularly chapter 6.

Closed systems and the monetary economy

In competitive equilibrium models, markets are of an atomistic structure, with homogeneous agents who are price takers. In chapter 2, it was argued that the economy is able to attain a general equilibrium thanks to a metaphorical auctioneer who collects information on scarcity and distributes it by communicating a set of relative prices by which all markets clear. Because of the presence of information, money is redundant, so that the economy is a 'neutral' economy in terms of Keynes (see chapter 6). In terms of chapter 5, such an Arrow-Debreu economy is of a statist-hierarchical kind. No social capital is needed, as all coordination is taken care of by the central auctioneer. As long as agents have all the information they need at their disposal, the closed system approach of general equilibrium economics would do well. The auctioneer would simply be replaced by a set of complete markets in which all relevant information is reflected in relative prices which result from market transactions. In fact, all agents have become auctioneers, since they all possess the information relevant to their intended transactions. However, this is not likely to be the case. What happens once the auctioneer is removed from the model?

In reality, information is incomplete or imperfect. The resulting outcome for the economy as a whole changes accordingly. Insofar as agents do meet at all, they will try to engage in bilateral trade in order to mitigate the gap between their preferences and their endowments. Microeconomic equilibrium

as well as a general equilibrium may be achieved, but are more likely not to be achieved. The economy as a whole, in which many tendencies interact and feed back upon each other, is better represented by an open system approach than by a closed system approach. Although the initial conditions of open systems can be known, the relevant parameters may be of an unmeasurable kind, such as qualitative variables. Even if the probability distribution of events is known, some events which have a small chance to occur may have such large impact that they cannot be neglected. The perception of the economy is perhaps best represented by chaos theory, which shows that bifurcation points can occur, in which processes can take either way. Relatively small events which occur at such points can be decisive to the path taken and thus have a large impact. Unforeseen events can be decisive to outcomes, so that an open system approach is not very attractive for those modellers who are focussed on predicting and want their models to generate a limited number of possible outcomes. However, once predictability goes at the expense of realism, or if the analysis of processes is hampered by a focus on determinacy of the model's outcomes, a case can be made for an open system approach (*cf.* Samuels, 1989, p.538). In particular, the monetary economy fits better in an open system analysis than in the traditional closed system approach. In an open system approach, the use of money as well as other conventions and institutions can be interpreted as ways of structuring the economy. This chapter explores an open system approach to the monetary economy.

7.2 The Concept of Stability

From the behaviour of groups of individuals under fundamental uncertainty, and by the way they cope with uncertainty by adhering to conventions and institutions, the stability of the monetary economy was underpinned. Individual behaviour is influenced by institutions at the aggregate level, which are created by individuals who interact regularly. In a monetary economy, which is characterized by fundamental uncertainty and historical time, sticky nominal wages and prices provide entrepreneurs, investors and others who

engage in contracts with an anchor for their expectations. By thus connecting the present to the future, nominal contracts facilitate trade in situations of uncertainty. However, because of uncertainty, these contracts are not likely to always be efficient, if the criterion of efficiency can be applied at all in situations of uncertainty. Moreover, efficient contracts do not always contribute to stability. In an economy in which decisions are irreversible and outcomes are not fully known in advance, coordination is necessary in order to stabilize the economy.

According to the above line of thought, nominal price stickiness and money-wage rigidity are preconditions to the functioning and stabilization of the economy because they facilitate coordination in a world of fundamental uncertainty and non-ergodicity (Davidson, 1994, pp.99-100; Rotheim, 1996, p.9). This conclusion seems to oppose the neoclassical point of view, in which price flexibility provides, or would provide, the optimal allocation of the means for investment and production. Financial capital as well as capital goods would be employed to their highest productivity. Furthermore, the neoclassical economic model would be stable thanks to both specific conditions with respect to income and substitution effects, and flexible prices, which adjust to changes in demand and supply conditions so that quantity adjustments need not be made and markets are cleared. Ergo, macroeconomic theory yields paradoxical answers to the question as to whether or not price flexibility facilitates or hampers stability. The respective assumptions made with regard to the information available to economic agents underlies the paradox. Therefore, the paradox can not be solved by merely calculating an 'optimal' degree of price flexibility, as such kind of calculation would require information which is not known in case of uncertainty. The impact of fundamental uncertainty and historical time on the monetary economy makes its difference from the neoclassical economy one in kind rather than degree.

Paradoxes

Seemingly opposite views can be treated in several ways, depending on the attitude of the theorist who is confronted with them. Chick (1995) gives four

ways of dealing with (apparent) opposites. The first one is rejection: considering two views as opposite and creating a hierarchy between the two. This combination of dualism with evaluation makes one theory 'correct' and the other 'incorrect' or even classifies them as 'good' and 'bad,' respectively, so that a choice can be made between the two. A theorist who prefers such a Cartesian mode of thinking will perceive any paradox as an opposition and defend either of the two approaches while opposing the other. Thus, in the first approach, a vertical dualism is created, as one of the two views is preferred above the other. The second approach strives for containment, by creating an encompassing theory of which apparently opposite views are parts. Marshall's partial equilibrium analysis with the three 'periods' can be seen as an example of the containment approach (Chick, 1995, p.31). The corridor approach by Leijonhufvud, which will be discussed below, is another example. The third and fourth ways of dealing with opposite views can be called Babylonian thinking, as opposed to Cartesian thinking. A theorist who is used to Babylonian thinking tries to solve the paradox by investigating the contingencies of both models to hold or even combining both views into a 'meta-model'.[1] The term 'Babylonian' refers to the variety of arguments and sets of axioms which are employed (Dow, 1985, p.14). The third approach to (apparent) opposites tries to accept both views as aspects of truth or reality, so that a horizontal dualism is created. Just like physicists consider light as both waves and particles, economists might accept the relevance of the coordination mechanism and the incentive mechanism, or the benefits of nominal price rigidity alongside those of price flexibility. The fourth approach aims at resolving the paradox by synthesis. The theory of self-organizing systems which will be discussed below is an example of such synthesis, as this theory encompasses both stability and instability in an integrated model of chemical systems. Equivalent theories in economics are hard to find and may not even

[1] On dualism in economics and Cartesian versus Babylonian thinking, see Dow (1990). On Babylonian thinking and Post Keynesian economics, see Chick (1995). On dualistic thinking in economics and the choice between integration or coexistence of two views, see Van der Lecq (1996).

exist as of yet (Chick, 1995, pp.26, 34). This chapter develops a modest attempt towards Babylonian thinking in economics, by comparing the concept of stability in closed system economics with the concept of higher order and increasing complexity in open systems from the natural sciences. The paradox of the impact of nominal price stickiness may be resolved by an open system approach to economics, which will be explored in section 7.3.

The corridor approach

In mainstream economic models, unique, stable equilibria are often sought for (Garretsen, 1991, p.420). Since (Post)Keynesian economists take the impact of fundamental uncertainty into account, the notions of equilibrium and optimization are less relevant to their theory. The two views can be combined into an integrated model, by way of containment, horizontal dualism or synthesis, as described above. An example of a 'containment' model is the 'corridor approach' by Leijonhufvud (1981, pp.109-110), with a corridor around the "full-coordination time-path." This path might be interpreted as a dynamic equivalent of the notion of a stable equilibrium used in chapter 6. Within the corridor the economy is able to return to the path. In the zone of homeostasis, "deviation-counteracting tendencies increase in strength" (*op.cit.*, p.109) so that the system is resilient. Leijonhufvud distinguishes between "moderate displacements" by which the economy remains within the corridor and "large displacements" which bring the economy outside the corridor. Large displacements are comparable to threshold effects which often occur in open systems. Threshold effects describe the large impact a small change can have in case it follows former changes. A standard example of a threshold effect is the 'last drop of water' in a bucket, which then starts to overflow. Similar thresholds can be thought of in an economy. In non-linear models, like OLG-models and chaos theory, they are represented by bifurcation points. Once they occur, the economy moves outside the corridor and may become unstable, as

in the model by Iwai discussed in chapter 6.[2] Keynesian effects emerge, since multiplier-effects bring the equilibrium in a state of effective demand failure and Keynesian unemployment.[3] Examples of far-out-of-equilibrium states are situations of hyperinflation, great depressions, and economies in transition (Leijonhufvud, 1992, p.19). The impact of shocks depends on whether the economy can remain within the corridor or is thrown out of it. Thus, Leijonhufvud's model contains two seemingly opposite theories by distinguishing mechanisms inside the corridor from those outside of it. Contrary to the argument of the present book, Leijonhufvud associates Keynesian effects with instability and neoclassical effects with stability. In other words, an analogy to the price rigidity paradox encountered above arises here. In both cases of the analogy, either school of economic thinking considers its own arguments as supportive of stability. To some extent, the corridor model by Leijonhufvud integrates neoclassical and Keynesian features. Still, the dualism remains, since the first theory is associated with stability and the second one with instability. Moreover, the paradigms underlying the two views on economics are not integrated. In particular, the impact of fundamental uncertainty, which is characteristic of Keynesian economics, is hard to reconcile with the notion of an equilibrium within the corridor, let alone a stable one. Once fundamental uncertainty is taken seriously, such an equilibrium is not likely to exist. At least, agents may not be aware of its existence. Therefore, the

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[2] In terms of Iwai (1981, pp.86, 140-142), the corridor might be called a state of 'secondary disequilibrium,' in which market gaps are closed but some firms' expectations may nonetheless be out of equilibrium, whereas large displacements, such as aggregate demand shocks, bring the economy out of the corridor into a state of 'Keynesian disequilibrium' or even one of 'Wicksellian disequilibrium,' in which a gap exists in the product market, the labour market or both. A 'Keynesian disequilibrium' "has a tendency to correct itself mainly through adjustments of quantity variables" (*op.cit.*, p.141), whereas a 'Wicksellian disequilibrium' is of a cumulative kind. In other words, the disequilibrium model of price setting behaviour by Iwai is compatible with Leijonhufvud's corridor approach.

[3] A situation of Keynesian unemployment can still be considered an equilibrium in the sense that no agent wants to make further changes to his position (*e.g.* Malinvaud, 1977, p.31), but apparently Leijonhufvud does not do so.

corridor-approach by Leijonhufvud can be characterized as an attempt to create an encompassing model which is only partially successful. Still, the concept of a corridor may be a helpful concept in thinking about stability.

Micro and macroeconomics

Besides the approach by Leijonhufvud, a different and complementary way of studying stability refers to the relationship between micro and macroeconomics. Following Weintraub (1979, p.175), macroeconomics can be distinguished from microeconomics by the criterion of whether or not coordination is considered problematic or taken as given, respectively. According to this criterion, in macroeconomics the focus is on the coordination problem while micro economics deals with the problem of allocation (Van Ees and Garretsen, 1990, p.124). Neither problem can be solved on its own. An even stronger emphasis on coordination is put by Loasby, who states that

> "The economic problem is the co-ordination of economic activities; and co-ordination is needed because specialisation is more productive than self-sufficiency." (1991, p.101; *cf. ibid.* p.10).

Specialisation can only induce higher efficiency if it is supported by coordination. In this sense, a case can be made for a macro foundation of microeconomics. The present de-regulation movement in The Netherlands can be seen as an example of trying to improve the workings of the incentive mechanism given that some degree of coordination has been realized. In case coordination is to some degree successful, the economy is rather stable in the sense that shocks are not likely to cause cumulative processes. However, it may be stable at an inefficiently low level of activity. Coordination is problematic in case of a high degree of uncertainty. For instance, the adjustment of relative prices to their 'optimal' levels is not relevant in times of restructuring, in which entire economic systems are transformed, such as in Eastern Europe after the fall of the communist system. Unless economies are stable to some extent, agents simply cannot rationally optimize for lack of a benchmark on which they can base their expectations. They may rather postpone their decisions or continue following their old patterns of behaviour until new formal or informal

institutions evolve (Van de Mortel, 1996). Quantity adjustments can contribute to stability if the economy has enough slack, *i.e.* buffer stocks, to absorb shocks, although quantity adjustments and the above ways of coping with uncertainty go at the expense of efficiency. Therefore, a lack of coordinating mechanisms frustrates attempts to improve efficiency (*cf.* Leijonhufvud, 1992, p.28). Mainstream economists contend that flexible prices improve the efficiency of the allocation, whereas Post Keynesians maintain that sticky prices improve the achievement of coordination. In a monetary economy, the latter are nominal prices. These seemingly contradictory statements raise the question as to whether there is some degree of nominal price flexibility which facilitates both coordination and allocation without one going too much at the expense of the other. In the flexibly coordinated economy, thanks to conventions and institutions which are part of the social capital of such an economy, nominal prices are adjusted only every now and then, in a more or less predictable fashion, so that attempts to improve the allocation are facilitated by some degree of coordination. By means of adjustment of conventions and institutions, as well as other measures with respect to macroeconomic order, coordination secures stability, and microeconomic policy can aim to create incentives towards efficiency. In this way, the monetary economy becomes resilient: over time it is able to absorb shocks without becoming in permanent disequilibrium from lack of information. Put differently, the economy adapts to changing circumstances without losing its essential characteristics. In the flexibly coordinated monetary economy, decisions are flexibly coordinated by means of conventions and institutions, besides the more commonly acknowledged coordinating function of markets. These norms for coordinating behaviour can evolve over time, so that they do not necessarily cause the economic order to be rigid. The present interpretation of the monetary economy may thus be an example of Babylonian thinking in economics, since both mainstream and Keynesian theories are integrated in one model in which they appear simultaneously.

Rationality and Behaviour

The mainstream equilibrium model and the alternative line of thought developed above, differ in their implications for economic behaviour of individual agents. In the standard model, the equally standard concept of *homo economicus* as an instrumentally rational, utility maximizing individual can be maintained. In optimizing his utility, the agent responds to relative prices. In the particular case of equilibrium models, the auctioneer takes care of maintaining the equilibrium outcome. However, in the alternative model, fundamental uncertainty causes relative prices to be either absent, because of missing markets, or wrongly set, because of missing information, so that the agent lacks the information needed to maximize utility (*cf.* Newbery, 1989). Moreover, once not all relative prices can be assumed as known, information on the behaviour of other agents may be lacking as well, so that neither coordination nor an efficient allocation is secured. As set out in chapter 4, agents coordinate by complying with norms for behaviour. Conventions and institutions make behaviour predictable. The better outcomes that may result thanks to the norms make complying with them an act of procedural rationality. Depending on the degree to which coordination and an efficient allocation are achieved, the implications for economic behaviour under uncertainty may look as follows (Langlois, 1986, p.178). Within the neighbourhood of a stable equilibrium, the agents show predictable behaviour because they have been able to find a 'sensible' or 'reasonable' way of making decisions given the uncertainty that is inherent in the economy they live in. This idea can perhaps be compared to Simon's notion of satisficing behaviour by boundedly rational individuals, since boundedly rational individuals also aim at a satisfactory rather than an optimal level of their particular targets. However, bounded rationality is not necessary for explaining predictable behaviour. Chapter 4 argued that procedural rationality can also explain complying with norms for behaviour. If the economy changes moderately, agents will be able to adapt their behaviour, at the expense of being less predictable to others, at least in the short run. Those agents who adapt their behaviour intend to gain from doing so, while the costs of diminished

predictability are borne by the other agents, so that a free-riding problem exists. As a second order effect, the costs of diminished predictability are also born by the adapting agents themselves: their decision to change their behaviour may induce other agents to behave in a less predictable fashion as well, because the benefits of predictability no longer exist, anyway. In a word, for the economy as a whole, allocative decisions are adjusted at the possible expense of coordination. In case the period of change is finite, this effect may be only temporary, so that predictable behaviour and coordination are restored. For instance, new conventions and institutions may evolve which govern behaviour so that after some time it becomes predictable again (*cf.* Boyer and Orléan, 1992). If the economy becomes volatile, as in times of large shocks, it can be argued that behaviour remains unchanged and thereby is highly predictable (Leijonhufvud, 1992, p.9). Agents do not know what to decide anyway, so they stick to old habits and conventions even if they know these are not reliable anymore (*cf.* Heiner, 1983). As Keynes describes behaviour in case of uncertainty or "a definite change":[4]

> "We tend, therefore, to substitute for the knowledge which is unattainable certain conventions, the chief of which is to assume, contrary to all likelihood, that the future will resemble the past." (Keynes, 1973, p.124)
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> "this convention by which we assume the future to be much more like the past than is reasonable [...] continues to influence our minds even in those cases where we do have good reasons to expect a definite change" (*ibid.*, p.125).

This reaction may not be preferable from an efficient allocation point of view, but it does contribute to coordination within an economy. The alternative reaction would be "to hold money as a store of wealth" because of "our distrust of our own calculations and conventions concerning the future" (Keynes, 1973,

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[4] The quote is taken from Keynes' article on "Some Economic Consequences of a Declining Population", a situation which can safely be assumed as being significantly different from the familiar situation of an increasing population, so that, in the article, the observation seems to refer to the thinking of the readers (*ibid.*, p.125).

p.116) and thereby diminish effective demand which brings the economy even further out of equilibrium. Hence, the predictability of behaviour alternates. This idea stems from Langlois (1986, p.178), who puts it as follows:

> "At first glance, we would seem to be left with a paradoxical result. A stable environment leads us to expect rigid and predictable behavior in our agent - but so does a highly volatile environment. There is, in fact, no paradox, of course, merely a spectrum."

The flexibly coordinated or network economy adapts to changing circumstances without losing its stability. Coordination is to some extent achieved and the incentive mechanism can perform its function in allocation. Therefore, the concept of the resilient monetary economy may be an example of combining two seemingly opposed views in economics, namely those that favour and those that reject nominal price stickiness.

Stable equilibria and closed systems

The mainstream approach is Cartesian in that an economy is considered as either stable or unstable. The concept of stability is connected with the concept of equilibrium, stability referring either to movements towards the equilibrium or to movements within the neighbourhood of the equilibrium. The way 'stability' is defined in The New Palgrave Dictionary (p.461), is illustrative of the second case:

> "A system is stable if, when perturbed slightly from its equilibrium state, all subsequent motions remain in a correspondingly small neighbourhood of the equilibrium."

Little or no meaningful statements can be made about the behaviour of variables outside the equilibrium. This is inherent to the concept of a stable equilibrium, because if movements of variables would not always be directed towards it, it would not be stable. The notions of an equilibrium and stability are elements of a closed system approach. The number of variables is limited and known in a closed system, as otherwise the model cannot be solved. Open systems have an unlimited domain, so that achieving determinacy is infeasible. The interaction of variables can be analysed, but the outcome for the system as

a whole cannot be determined. As time is historical and processes are irreversible, open systems require an evolutionary perspective on stability rather than a static one.

The implications of such an evolutionary perspective on the analysis of open systems can be seen in biology. If a plant is taken as an open system, as biologists do, then it does have boundaries. Still, its morphological development, the phenotype, cannot be completely predicted from the information known at the outset, the genotype, since the plant interacts with and adapts to the changing conditions of its surroundings, while simultaneously being integral to it, that is, paradoxically, being "boundary-less." The information of its DNA is both a blueprint and a database, and the exchange of energy between the organism and its surroundings can be viewed both as inside-outside and as a continuum. The distinction is, in fact, not paradoxical but artificial. Initial conditions set the tone in which self-organization at all levels actually leads to an increased order and increased complexity.

While section 7.3 explores the notion of self-organization, the topic of analysing open systems in economics is discussed, here. In natural science, an isolated system exchanges neither energy nor matter with its surroundings. A closed system may or may not exchange energy. An open system "imports" energy, in particular so-called low-entropy / high-grade energy. At the same time, it "exports" high-entropy / low-grade energy. Roughly, the first kind of energy can be said to be productive, so that the system can produce work, while the second type is dissipated while work is done, as for instance the heat produced while moving an object (Brooks and Wiley, 1988. p.57). In other words, an open system acquires useful, productive energy while it gets rid of useless, waste forms of energy.

In an open system approach to economics, the exchange between the system and its surroundings may refer to information (England, 1994, p.198). The exchange of information between a system and its surroundings differs from the way information is dealt with in open and closed models. In a closed economic model, no exchange of information is needed to solve the model. The

number of endogenous variables equals the number of equations, so that the model can be solved. An open economic model can be indeterminate, so that exogenous variables are needed in order to solve it. Hence, extraneous information is needed. For instance, overlapping generations (OLG) models are often indeterminate. Expectations, nominal prices, or other exogenous variables, are needed in order to arrive at a particular solution for the OLG-model (Geneakoplos and Polemarchakis, 1986; Garretsen and Janssen, 1989). Open systems and exogenous variables do not go together, since exogeneity implies a boundary between the system and its surroundings, and thus a closed system. Therefore, in order to represent an open system, either an open but indeterminate model would be appropriate, but would be of limited use, or an infinitely large, closed model would have to be built, which is likely to be intractable let alone provide any insights which were not already there, before. In both cases, a reorientation on the aim and method of modelling is required.

Instead of focussing on the possibilities and limitations of economic modelling, the open system itself can be taken as a starting point. A sketchy outline of the way in which an economy can be interpreted as an open system is the following. Fundamental uncertainty and historical time together are the essential characteristics of a monetary economy. In such an economy, agents lack the information they would need in order to arrive at a general equilibrium. Instead, the economy they live in is a complex reality. In order to act, agents construct their own, subjective models of the economy which help them to make decisions. The outcomes of these models can be supplied with auxiliary assumptions. The models represent the part of the economy the agents know and understand, at least partially, while the rest of the economy remains the unknown surroundings in which the agents operate.

A network, or a group of agents for which the above story holds can then be seen as an open system. Interactions provide the individual agents with information by which they can update and refine their subjective models of the economy. Information enters into the individual models of agents, as they acquire knowledge and experience by which they increase their awareness and understanding of the surroundings of their "system." This "high-grade energy"

is used for ordering that part of the economic reality which is captured by the model. The agents lose productive capacity by allocating their effort to improving their models, for instance by acquiring and processing the information available to them. They are, so to say, to a slight degree less available for entering into market transactions, which may diminish transaction efficiency of the economy. These losses are more or less fully compensated for[5] by the benefits of increased order: by a better understanding of the economy, agents are able to act more consistently. Their behaviour becomes more predictable, so that transparency increases and transaction costs can be reduced. For instance, by a better understanding of the markets agents operate in, they can reduce their costs of searching as well as those of their potential trading partners. The more information they possess and the better they are able to process the information, the further the boundary between their models and the surrounding world is extended. Analogous to the interpretation of a plant as an open system, the boundary between the model and the unknown part of the economic reality is both artificial and a continuum. Moreover, by consistently acting upon their models, they create structure in the economy they live in. Thus, the flexibly coordinated economy discussed in chapter 5 can best be analysed by an open system approach.

For the sake of clarity and completeness, it can be mentioned that viewing the economy as an open or closed system differs from the distinction between models of open and closed economies. The distinction between open and closed economies is well known and refers to the exchange of money and commodities across the borders of the countries which are modelled. For example, many models of open economies view these economies as closed systems, because they take the 'rest of world' as given instead of modelling the interaction between the open economy and its environment. Thus, the distinction between open and closed economies goes together with a boundary between 'inside' and 'outside' and the matter which is exchanged between the

[5] Due to fundamental uncertainty, the decision to devote resources to acquiring more information and understanding results from a trial-and-error rather than an optimization process.

two is physically identifiable. Both models of closed economies and models of open economies are closed system models. However, as is clear by now, the world economy itself is an open system: it cannot evade influences from state-of-world variables such as demographical factors, wars, famines, and other shocks which are only partly predictable. The influence of shocks in technology, in particular qualitative shocks, may or may not be contained in the model. Even though a probability distribution might be known, the time span or the number of events may make the least probable outcome a possibility to be taken seriously. The need for setting boundaries in order to model the economy makes any model of the world economy a closed system approach and thereby excludes factors which may be more influential to outcomes than the variables which are included in the model. From the point of view of economic model building, an open system approach is likely to be either infeasible or it imposes the necessity to develop different styles of modelling. The latter may be facilitated by studying open system models from physics, chemistry and biology. For a monetary economy in particular, turning to an open system approach is as necessary as it will be rewarding, because the essential characteristics of the monetary economy can then be dealt with.

Mainstream theory takes a closed system approach by constructing 'objective' models. By implication, it contends that an economy with fundamental uncertainty and historical time, if such an economy is considered at all, is likely to be unstable as only risk can be hedged against and time is neglected. Oppositely, (Post) Keynesian theory suggests that the economy is stable thanks to the way heterogeneous agents deal with uncertainty over time, for instance by building their own subjective models.[6] (Post) Keynesian theory acknowledges the limitation of representing an open system by a closed system model, and focuses upon the subjective individual models agents hold of

[6] The two types of theoretical models are chosen as benchmarks, because both theories claim to deal with the monetary economy. 'Mainstream theory' refers to both neoclassical and New Keynesian modelling as opposed to heterodox economics such as Post Keynesian and Austrian theorizing. Institutional economics can be positioned relative to the two, depending on the branch of institutional economics (see chapter 4).

reality, instead. In mainstream theory, information transmitted by relative prices guides agents towards the equilibrium, whereas in (Post) Keynesian theory agents manage to do well without such information or with less of it. In terms of Shackle, such a 'kaleidic,' Keynesian procedure of analysis represents agents as constructing their own reality in which they operate with reason, as if they had sufficient data. The "materials for reason" agents use are "continually altering in composition and in the light which they throw on each other" as in a kaleidoscope (Shackle, 1974, pp.76-77). The agents choose such a way of contructing their reality not only because of efficiency considerations, as these are quite irrelevant in situations of fundamental uncertainty, but also because it has become part of their identity to act this way. The "schemes" or mental frameworks (see chapter 4) agents use "inform them on how to perceive the environment and divide it into resources and opportunities" (Khalil, 1996, p.24). In a monetary economy, nominal prices only partly reflect scarcity, since they perform other functions as well (see chapter 3). They are "material for reason" in that they reflect the many transactions between agents in an economy, and provide the agents with information by which they can decide and act. Whereas neoclassical modelling studies the (lack of) stability of equilibria by analysing its reaction to small perturbations, Post Keynesian analysis aims to explain why only small fluctuations rather than chaotic outcomes result in spite of fundamental uncertainty, positive feedback mechanisms and threshold effects.

Higher order stability

This ends the discussion of the notion of stability as it is used in mainstream, closed system economics. In this framework, the term stability refers to equilibria and has the connotation of variables returning to their equilibrium values after a perturbation. In the remainder of this chapter, the term stability is used as a characteristic of the entire economic system rather than its equilibrium state. Then, stability does not refer to moving back to the old situation, or moving to new equilibrium values, as variables in a stable equilibrium would do. Instead, it refers to the capacity of an economy to absorb

shocks without losing its essential characteristics. In order to distinguish the two interpretations of stability, the second interpretation is called higher order stability. It will be argued that the capacity to absorb large shocks stems from conventions and institutions as means for an economy to self-organize and thus adapt to new circumstances. Moreover, this capacity has to do with the open system character of the monetary economy, since open systems can self-organize and thereby achieve higher-order stability.

7.3 Open Systems and Self-organization

In this section, an analogy between the above discussion on stability and some notions from natural science is explored. In particular, the concept of the self-organizing economy is introduced and compared to the concept of a dissipative structure.

The concept of the self-organizing economy can be introduced together with the concept of dissipative structures from natural science. Both notions refer to the capacity of seemingly unstable systems to self-organize. Self-organizing systems can be described as "systems that, even when they start from an almost homogeneous or almost random state, spontaneously form large-scale patterns" (Krugman, 1996, p.3). Self-organization can take place over space and over time. Krugman (*op.cit.*) gives examples of both, such as the location of businesses and the size distribution of cities, and business cycles, respectively, with a heavy emphasis on the spatial forms. In the present chapter, both the monetary economy and dissipative structures will be interpreted as a manifestation of self-organization. By implication, the emphasis is on self-organization through time.

Entropy[7]

The first law of thermodynamics refers to the conservation of the total quantity of energy of a system, even though it may be converted into different forms. The second law of thermodynamics differentiates reversible from irreversible processes by use of the concept of entropy, which can be interpreted as a measure for chaos. The law states that closed systems will move towards states of higher entropy. If entropy increases, structures break down and a system becomes increasingly homogeneous. For instance, if two kinds of liquid are brought together, they diffuse until they are mixed up. Another example is the degeneration of organic material into an amorphous mass. The heat which is 'lost' during physical labour warms the surroundings of the labouring entity, so that temperature becomes increasingly homogeneous. The information contained in the structure gets lost as chaos increases, so that the process cannot be reversed. For example, one cannot 'un-stir' a scrambled egg. By implication, the second law of thermodynamics brings in historical time, or Prigogine's "arrow of time" (*cf.* England, 1994, p.202). In chapter 2, it was derived that historical time is intrinsic to a monetary economy, so that the second law of thermodynamics may go together with this kind of economy. Further, by its irreversibility, the system is more sensitive to its initial conditions, because they cannot be undone. In chapter 4, the path dependence of norms for behaviour was already discussed. In OLG-models, initial conditions matter as well, as they determine which of the multiple equilibria is selected, particularly at bifurcation points (*e.g.* Weddepohl, 1990).

Dissipative structures

In order to capture some of the conceptual implications of the second law of thermodynamics, the difference between equilibrium and order needs elaboration. The concept of equilibrium is applicable to closed systems. An

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[7] Georgescu-Roegen was one of the first to thoroughly explore the impact of the second law of thermodynamics, or entropy law, on economics (*e.g. The Entropy Law and the Economic Process*, 1971). However, the present chapter uses work by other authors as it explores later work in science on the reduction of entropy.

equilibrium refers to a state of homogeneity, in which entropy is at a maximum. All individual entities, such as molecules, behave similarly. In thermodynamics, one can think of the loss of heat which goes together with a loss of working potential. If no new energy is added once the equilibrium temperature is reached, no more useful energy is available. The loss of energy is an irreversible dissipation, by which entropy reaches its maximum in the equilibrium (Brooks and Wiley, 1988, p.53). Information on how the equilibrium came about is diffused, so that the initial state from which the equilibrium was attained can hardly be reconstructed (*cf.* Prigogine, 1993, pp.11-12). The neoclassical general equilibrium model can be seen as the economic counterpart of such closed system modelling, because it analyses equilibrium as the outcome of a timeless process in which all relevant information is known. By assuming a closed system, the modeller can determine an equilibrium point (Brooks and Wiley, 1988, p.57). Non-neoclassical concepts of equilibrium, such as the Keynesian underemployment equilibrium, may not satisfy the description.[8] Distinct from the concept of equilibrium, order refers to a structure. Order cannot be but a state of heterogeneity as any structure is distinct from its environment. For instance, agents whose production is internalized by an organization behave differently from agents who deliver their production via market transactions. According to the entropy law, structures in closed systems will break down until an equilibrium state of homogeneity is reached. However, open systems are able to reduce the chaos and maintain a state of low entropy because they can interact with their environment. Open systems reduce their entropy by their capacity to self organize, which is the reason why they are called dissipative structures: they do away with chaos (Prigogine and Stengers, 1985, p.12). As will be explained below, the emergence of a state of order can take place once

[8] One can also distinguish between types of equilibrium. Chick and Caserta (1994) distinguish final equilibria, being those equilibria "after which the economy may replicate its activities, but there are no further changes" from provisional equilibria, which may change because of shocks, innovation, learning and evolution. From this description, it seems that the present use of the term equilibrium resembles the final equilibrium, while higher order stability is comparable to a provisional equilibrium. Whether a provisional equilibrium equals a punctuated one is not entirely clear.

a system is in a far-from-equilibrium state, that is, structure evolves in an unstable system (Radzicki, 1990, pp 82-83). Both an equilibrium and a state of order can be stable. A stable equilibrium is an equilibrium whose variables, once the equilibrium is disturbed, return to their equilibrium values. A stable state of order refers to the possibility of an economy to react to shocks without disrupting the way the economy is organized. The economic system as a whole shows this 'higher order stability' once it is also able to re-organize itself if changed circumstances make such creation of new structures necessary.

Structures which create order in a system, evolve from repeated interaction of the system's components or a disruption of the system by forces outside of it. In chapter 4, the evolution of norms from repeated interaction of individuals has already been described. The evolution of languages might have gone along the way of repeated interactions from which patterns of sounds emerged and created the patterns of words and sentences of a language (Zuidema, 1997). Bottom-up processes can be simulated within the discipline of artificial intelligence or artificial life (Kamping, 1996). Like patterns of language emerge bottom-up, so do patterns of transactions emerge in an economy. In essence, neoclassical equilibrium theory is a top down approach, because its models deliver the optimal solutions to a social planner's problem (Leijonhufvud, 1992, p.7). Oppositely, in a truly decentralized economy, agents know less than the central planner is supposed to know. By interacting in a network economy, they constitute bottom-up coordination. The use of money and patterns of nominal price setting behaviour are structures of such bottom-up coordination. A monetary economy thus differs from the centralized neutral economy of general equilibrium models, since top down planning by centralized institutions is accompanied by bottom-up coordination by decentralized norms for behaviour, as described in chapter 6.

Exploring the analogy of the entropy law to economics seems useful within the context of this chapter, because it deals with characteristics of systems that consist of particles, like an entire economy consists of many individuals. A chemical substance behaves differently from individual molecules, like an economy differs from behaviour of its individual agents. In

both cases, simply adding up individual units is misleading (*cf.* England, 1994, p.204). Ant hills and bee colonies can also be considered examples of self-organization by which the characteristics of the system as a whole differ from the behaviour of its individual parts. In order to analyse macroeconomic phenomena, studying the system as a whole is more revealing than starting from the individual unit, as is done by those economists who search for a microfoundation of macroeconomics. By adding up the individuals who constitute an economy, one neglects their interaction. The contributions of game theory to analysing interaction show the serious limitations of simply "multiplying individual behaviour by the number of agents." In fact, the assumption of homogeneity of agents allows for neglecting their interaction. However, once agents are allowed to differ, which is not only realistic, but also necessary for specialisation and exchange to take place, problems of aggregation arise, which cause large scale outcomes to differ from small scale outcomes. From repeated interaction, complexity emerges, because feedback effects can operate (Krugman, 1996, pp.2, 3, 15). The interaction between particles in a chemical substance, by which both transform the information they contain, resembles the many market transactions in an economy which change demand and supply conditions. In a general equilibrium, all agents are to some extent homogeneous: their preferences may differ, but they all satisfy the criteria of completeness, local nonsatiation, monotonicity, convexity *et cetera*. (Varian, 1992, pp.93-97). For example, in a decentralized exchange economy with perfect competition, the individual agents interact until all agents have zero excess demand. Because of the atomistic structure of markets and the many transactions involved, information on former states of the system diffuses and is mixed up with new information on recent states of the system. Entropy increases and cannot be reduced, because the economy is modelled as a closed system. The more homogeneous the system becomes, the less agents differ from each other in their present demand and supply conditions, and the more entropy, or chaos, results. The flexibility of prices contributes to the chaos, because these prices reflect scarcity and thereby diffuse information on demand and supply conditions. Based on these flexible prices, trade takes place so that

the homogeneity increases.

Opposed to this equilibrium oriented tendency, open systems are able to organize themselves by the creation of structures that shape order. The order which emerges in patterns of stock markets data, like patterns which resemble fractal models,[9] may be an example (Van den Berg, 1996). Other economic equivalents of such structures have been discussed at length in chapters 4 and 6. In an open system economy, conventions and institutions function as higher levels of complex organization that spontaneously arise, because they create order in the economy. The connection between entropy and institutions has been made elsewhere as well, for example: "A social institution, then, is a mechanism to reduce the entropy" and "... an institution creates predictability - it brings order out of relative chaos." (Langlois, 1986, p.175, 174). In terms of economics, the theory of self-organization provides an 'invisible hand'[10] explanation, because it explains the mechanism by which behaviour of individual entities, even if unintended, creates a beneficial outcome at the aggregated level.

In thermodynamics, a complex organization is characterized by disorder at the microscopic level and order at the macroscopic level (Brooks and Wiley, 1988, p.71). The flexibly coordinated economy can be seen as a complex organization insofar as the economy as a whole is ordered and robust to shocks, while individual agents are not dictated to behave in particular ways. They rather organize their interactions in more or less spontaneous ways, which is reflected by conventions and institutions. Like a complex organization may increase its complexity by importing high-grade energy from its surroundings,

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[9] Fractal models belong to chaos theory, which may be confusing in the present context. However, they describe the emergence of a particular pattern from chaos. For the same reason, chaos theory itself can be interpreted as a subset of the theory of self-organizing systems (*cf.* Radzicki, 1990, p.82). In other words, chaos theory studies patterns which emerge out of chaos rather than the state of maximal entropy itself. Interestingly, these patterns themselves can be surprisingly simple (Krugman, 1996, p.36; Van den Berg, 1996).

[10] The 'hand' is less visible in case of conventions than in case of institutions, since the latter can result from a conscious design of a set of rules and sanctions, while the former often evolve spontaneously (see chapter 4).

the increased availability of information can contribute to higher levels of organization in an economy. Information becomes available to agents thanks to their searching efforts, which are likely to partly go at the expense of producing output, and their interactions with other agents. The agents use the information to bring order in their own understanding of the economy, that is, their subjective model of reality, and to order the economy itself by structuring their interactions.

Feedback mechanisms

The higher order stability of an open system is derived from its capacity to organize and re-organize itself. For example, an ant hill is able to create a new order once the hill is disturbed. In an economy, conventions and institutions are means of self-organization, because they constitute a pattern of behaviour of the economy as a whole. Within the pattern, positive feedback effects and negative feedback effects operate.

Positive feedback effects amplify a tendency, which makes them self-reinforcing. Negative feedback effects diminish a tendency and thereby act as automatic stabilizers. The balance between the two determines the outcome of a process and the resilience of a system. For instance, it determines whether a business cycle is dampened, stable or 'explosive'. The result partly depends on the balance between the self-enforcing character of investment behaviour and the coordination problem involved versus the diminishing marginal returns to investment, which have a stabilizing effect (Krugman, 1996, p.68). In economics, positive feedback mechanisms stem from different sources: large set-up or fixed costs, which cause unit costs to fall as output increases, learning effects, which also make production costs per unit decrease or increase quality, coordination effects, by which complying with others is profitable, and self-reinforcing expectations (Arthur, 1994, p.112). In different fields of economics, they are given different names, such as increasing returns, cumulative causation, deviation-amplifying mutual causal processes, virtuous and vicious circles, threshold effects, and nonconvexity (*ibid.*). Their self-reinforcing effect gives rise to path dependence.

Negative feedback effects stem from diminishing marginal utility or productivity, for instance. Without negative feedback, systems would be unstable because tendencies are never mitigated, as situations of asymmetric information illustrate, *e.g.* the lemons' problem described by Akerlof (1970). Problems of congestion also show negative feedback mechanisms. The focus of economic modelling on closed systems and equilibria, as well as past limitations to computing capacity help to understand the traditional emphasis on negative feedback or 'stabilizing' effects as opposed to positive feedback or 'destabilizing' effects.

Positive and negative feedback effects can be interpreted in terms of the coordination problems of a monetary economy. The positive feedback effects, which are mutually reinforcing, consist of interdependencies in the formation of expectations and the actions that are built upon them. Strategic complementarities and spillover effects can cause an economy to be subject to a coordination failure and reach a Pareto inefficient equilibrium (Cooper and John, 1988, p.442).[11] An example of mutually reinforcing expectations can be found at stock exchange markets in which interdependent decisions cause speculative bubbles and stock market crashes, like in the 1980's. Variables referring to the economy as a whole would be less volatile if not all agents held the same expectations (Hoogduin, 1996, pp.9-10). The fact that most of these differing expectations of variables are 'wrong' as compared to the equilibrium values of these variables is mainly relevant at the level of the individual agents, who may lose from trading upon incorrect expectations. The stabilizing effect of different expectations for the economy is more relevant at the aggregate level, though it feeds back upon the individual agent, as was discussed in section 6.2 on Iwai's model. In other words, from the point of view of stability, a case can be made for heterogeneity of agents. Then, a negative feedback mechanism may operate: expectations are no longer self-fulfilling and movements out of equilibrium are more or less dampened, depending on the

[11] The reference to this article is not to imply that Cooper and John took an open system approach to analysing the economy. It rather indicates that elements of explaining self-organization can be useful in closed system analysis as well.

impact of trading losses on other transactions. When applied to norms of behaviour, positive feedback effects work out to improve stability over time. The simple example of two opposite drivers on a road, who both expect to pass each other on the left-hand side, illustrates this. In case expectations concerning agent's conformity to norms reinforce each other, the norms are complied with, behaviour can be predicted, and the economy gains higher order stability, that is, its functioning is robust to shocks. Thus, the uncertainty inherent to open systems may contribute to stability rather than hamper it, because economic agents are more likely to differ in the expectations they make, so that negative feedback mechanisms can work as described. This conclusion is exactly opposite to the closed system approach of neoclassical economic models, in which complete and perfect information contribute to the stability of equilibria.

Thresholds

Models from artificial intelligence, such a neural networks, are increasingly used for modelling economic systems, because they consist of many interacting elements which together constitute a system. Neural networks consist of many receptors which are interconnected. In neural networks, incentives are transported between receptors, so that part of the network becomes activated. The pattern of activation is determined by mechanisms such as positive feedback, negative feedback and threshold levels. The first two were discussed above. The latter means that the receptor's condition of being either 'asleep' or 'active' switches abruptly once the incentive has reached a critical level, so that it behaves as a binary variable. The critical level can be endogenously determined by the history of the receptor, *e.g.* the frequency of having been active in the past. This simple illustration of the many stabilizing mechanisms that form part of a neural network resembles the feedback mechanisms and discontinuities encountered in the monetary economy.[12] The combination of negative feedback and thresholds results in overshooting, comparable to the

[12] For an introduction to neural networks, see De Bono (1991, pp.72-78) and Hofstadter (1979, Ch.XI).

workings of a thermostat-mechanism (Schelling, 1978). As Schelling describes, thermostats tend to react too late and too strong, thereby causing cycles instead of correcting perturbations from the equilibrium level of a variable. The "large displacements" of Leijonhufvud discussed earlier also function as thresholds in that they bring the economy far out of the initial equilibrium situation. Several ways of modelling thresholds, such as squasher functions and step functions are given by Sargent (1993). These kinds of models can be used for formalizing the threshold effects involved in the adoption of a convention, such as money, or the institutions that go along with its use, by a critical fraction of the economy. To sum up, neural network models, with positive and negative feedback effects as well as thresholds, may be an appropriate way of modelling the evolution of conventions and institutions, as well as their impact on the economic system.

Neural networks show patterns which emerge at a macroscopic scale by the interaction of many individual units, so that they may serve to explain patterns of group behaviour. For instance, large organizations can perform adequately thanks to either a hierarchical organization or innumerably many interactions within the network of its employees. At first sight, the interaction may not seem structured, but at the aggregate level, a stable pattern of the organization as a whole emerges, as the example of the ant hill illustrates. The many instances of bilateral communication in large organizations, or in bee colonies, may seem chaotic but can result in a rapid dissemination of information.

The source of change may come from technological breakthroughs or entrepreneurial activities, which disrupt an existing situation. For instance, the development of railway transportation was a movement out of equilibrium at first, but gave rise to new networks and forms of order in second instance. Another example may be the development of electronic means of payment, which changed the conventional banking and payment infrastructure and timing schedules. It allowed people to control the electronic transfer of their funds and gave them access to real time information concerning their bank accounts at little or no transaction costs. The increasing influence of banks on

trading and investment at the turn of the century also forms a case in point. In all examples, the economy adapted to the new situation created by some of its agents thanks to inductive learning by others. In other words, besides the shock in technology itself, a shift in patterns of behaviour occurred, which allowed the economy to re-organize itself and thus adapt to the changed situation. The disturbance of the old equilibrium resulted in a shift towards a qualitatively new equilibrium thanks to the change of conventions and institutions.

Another source of instability of the system may come from "outside". Fluctuations in the surroundings of the system may cause the boundary conditions to affect the workings of the system, so that it starts organizing or reorganizing itself (Brooks and Wiley, 1988, p.57). The reorganization of economic institutions due to increased awareness of the ecological impact of economic activities may be an example. The increased awareness of the impact of economic action on the physical environment can cause agents to change their model of the economy and allocate resources to developing new technologies or new transactions, *e.g.* "green electricity" and "green investment." The impact of information science and electronic communication can serve as another example. This shift in technology changed the way agents perceive the world, with the introductions of television and the Internet as most prominent examples. Moreover, this revolution in communication also changed the distinction between the subjective models of agents and the unknown surroundings of it, since much more information has become available. For instance, the Internet allows for virtual shopping, thereby increasing the number of possible transaction partners to such extent that the impact on search costs is ambiguous.

Time

According to the second law of thermodynamics, time is irreversible (Prigogine and Stengers, 1985, p.12). Thus, the invention of the law broke with classical mechanics, in which time used to be reversible (*cf.* Chick, 1995, table 2.1). An analogy can be drawn with neoclassical economics which uses logical time and considers economic processes to be reversible, as was discussed in chapter 2. In

this analogy, heterodox economics can be said to incorporate the notion of entropy, by using historical time and explicitly taking into account the fact that the quality of information changes during the economic process. This makes a reversal of time impossible, like the infinite entropy barrier does in science. The infinite entropy barrier refers to the notion that processes cannot be reversed, because it would require an infinitely large quantity of information to reconstruct former situations in the system. The fact that processes cannot be reversed implies that initial conditions matter very much. Not only by unforeseen events, but also by the arbitrariness of initial conditions, chance is introduced in the system. Even sheer coincidence may have as large an impact as economic fundamentals, as models of sunspot equilibria show. Initial conditions, constraints, and chance together determine the outcomes of processes in an open system. Chaos models show that the time-path of the economy can be highly sensitive to initial conditions. The second law of thermodynamics thus introduced an "arrow of time" (Prigogine) into science, which made it different from Newtonian physics. In the same way, heterodox economics differs from neoclassical economics, because time is historical and outcomes of processes are likely to be path dependent. They are even dependent on the way agents construct their individual subjective models, because the outcomes of these models determine their decisions and their interactions (Shackle, 1974, p.76). Entropy directly connects time with information, just as historical time and uncertainty are interrelated in heterodox economic theories of a monetary economy (*e.g.* Davidson, 1978, p.360).[13] As information is lost as time goes on, one could even say that time is defined by information (*cf.* Prigogine, 1993, p.6). In economics, nonlinear models, such as the earlier mentioned OLG-models with bifurcations, show similar

[13] It may even be the case that an analogy can be drawn between the treatment of energy in post-thermodynamics science and money in heterodox economics. For instance, energy can be transferred into labour, but 'friction' causes part of the energy to be lost in the form of heat. Likewise money allows for trading, but part of it goes to transaction costs which result from 'frictions' in the dissemination of information. Other, related ideas can be found in Mirowski (1989). Criticisms on economic theories which refer to the entropy law, or science in general, are discussed by England (1994, p.201).

irreversibilities. Opposed to this view, in an Arrow-Debreu economy all relevant information is present and, simultaneously, the concept of time has lost its meaning. Analogously, classical mechanics is timeless as potential energy can be converted into kinetic energy and *vice versa* without the past influencing the present. If all information is assumed to be present, as in general equilibrium models, then the past and the future are contained in the present, so that time is meaningless. Therefore, the direct connection between time and information is only relevant in cases where not all information is present. In a situation of uncertainty, information irreversibly evolves over time (*cf.* Prigogine, 1993, p.11).

Evolution

In chapter 4, the emergence of conventions was discussed at length. The problem involved in explaining the first stage of evolution was dealt with by either assuming asymmetry of players of the coordination game, or by assuming a focal point strategy to exist, or by rejecting the assumption of a state-of-nature. It turned out that the emergence of conventions could hardly be explained from an entirely neutral initial situation in which all agents and situations are homogeneous. The same holds for patterns of self-organization. As a homogeneous equilibrium is an entropy maximum, evolution goes together with a decrease of entropy. Therefore, an ordered state of low entropy is not an equilibrium[14] (Brooks and Wiley, 1988, p.57). The symmetry of the homogeneous equilibrium state needs to be broken in order for structures to emerge. This can be illustrated by the example of the growth of an embryo which would be impossible if all of its cells remained the same. An embryo can be considered as partially open, because it uses a set of information given by its DNA in addition to the information it imports from its surroundings. In this example and the next one, the homogeneity of the equilibrium symmetry of all elements has to be broken. In general, the original structure has to become

[14] In natural science, this situation is called a steady state (Brooks and Wiley, *op.cit.*, p.57), but this term has a different meaning in economics and is therefore avoided here.

unstable before new structures can emerge (Prigogine and Stengers, 1985, p.173). This break of the original symmetry can happen because of changes in the system's surroundings, as mentioned above, or by a spontaneous decrease of entropy due to new information, of which innovational breakthroughs can be an example (*cf.* Brooks and Wiley, 1988, p.57). The other example is taken from evolutionary theory in biology. In older versions of evolution theory, life was said to emerge out of a 'primal soup.' The problem with this theory was that the first beginning of life could not be modelled. Put differently, as there was no information distinguishing one part of the soup from another part, as the gasses of which it exists diffuse, the timing of the initial process of life to start was completely arbitrary. The alternative metaphor of the 'primal pizza,' consisting of a flat surface of a particular material surrounded by several types of gasses, met these conceptual problems. The pizza-metaphor was supported by, or perhaps it even emerged after, research which showed that primal protein chains (amino acids) were relatively easily formed at surfaces of pyrites, for a large part because gas molecules have a higher chance to react on a flat surface than in three-dimensional space (Schilthuizen, 1996). Life structures could come into existence thanks to, rather than in spite of, discontinuities (*cf.* Chick, 1995, p.34). The information in the system starts to change, and the irreversible process of evolution brings in time. For structure to emerge, the system needs a disturbance from its initial equilibrium, which must be unstable, so that a movement out of the homogeneous equilibrium is possible. An example of order which arises out of an unstable and disturbed homogeneous equilibrium is given by Schelling (1978) and repeated by Krugman (1996). It is a model of a lattice of which the cells can be 'occupied' by two kinds of agents. Initially, the two types are equally distributed, so that all have as many neighbours of their own kind as of the other type. However, once some cells are left open in order to make room for movements and once it is assumed that the agents prefer their own type of agents as their neighbours, they start to move. Open spaces are filled by movers, who leave open free cells for other movers in turn. Within a limited number of iterations, an order emerges by which the two kinds of agents are spatially distributed. Krugman remarks that the

resulting order is not always a desirable outcome, as self-organization models of racial segregation in cities illustrate (*op. cit.*, p.20). Still, the example usefully illustrates that a small perturbation in an unstable system can result in an orderly structure. Order not only replaces chaos, but results from it once instability arises. Thus, a four stage process results, with a structure which is in equilibrium as the initial state, then a shock, followed by disequilibrium or chaos, which is transformed into a new structure as the final stage of the process. Disequilibrium or chaos is thus a necessary condition for order rather than an inhibiting factor. The same may hold for a monetary economy, which can become unstable, but seldom does so, as was set out in chapter 6.

7.4 Conclusion: The Self-organizing Monetary Economy

After the above excursion into science and the parallels with economics, some conclusions can be drawn with regard to the monetary economy. In general, the theory of dissipative structures may be used to analyse the thesis of chapter 6, which argued that the monetary economy may be rather stable in spite of destabilizing tendencies which are assumed to follow from uncertainty. The exploration of the analogies with thermodynamics and some constructs from artificial intelligence suggests that an open system approach to economics may explain the emergence of stable structures in an inherently unstable environment. The evolution of norms for behaviour, as discussed in chapter 4, can be seen as the emergence and persistence of such structures which enhance coordination in a fundamentally uncertain context. Moreover, most of these norms develop in a decentralized economy rather than being consciously created at a centralized level. Hayek also emphasizes the contribution of rules for behaviour to order in the economy:

> "Concerning our modern economic system, understanding of the principles by which its order forms itself shows us that it rests on the use of knowledge (and of skills in obtaining relevant information) which no one possesses in its entirety, and that it is brought about because individuals are in their actions guided by certain rules.

> Certainly, we ought not to succumb to the false belief, or delusion, that we can replace it with a different kind of order, which presupposes that all this knowledge can be concentrated in a central brain, or group of brains of any practicable size." (Hayek, 1978, p.13)

The last sentence from this quote may be interpreted as supporting the thesis that models with a centralized auctioneer are of little use for analysing a modern economy, which is a monetary economy. Moreover, if the model is to be one of a monetary economy, the uncertainty is of a fundamental character. Together with fundamental uncertainty, the role of time becomes important. Both phenomena create room for using money. The notion of historical time captures the irreversibility of transactions, whereby the state of the economy differs from one moment to the other. Once the general equilibrium model is amended by introducing uncertainty, its equilibrium may become unstable. As Iwai's model, which was discussed in chapter 6, convincingly shows, cumulative inflationary or deflationary processes may cause the economy to never return to its equilibrium state. The same can be said in terms of the difference between a monetary economy and a neutral economy in the sense of Keynes as discussed in chapter 6. In the neutral economy, time is reversible, and the system is in an equilibrium state of homogeneity or, by the entropy law, on its way towards it. In the terminology of thermodynamics, a neutral economy is in a chaotic state, comparable to the 'primal soup.'

From the point of view of mainstream economics, the instability of the monetary economy is considered problematic. However, an open system approach reverses the conclusion. The theory of dissipative structures teaches that open systems are able to self-organize. The very instability of their equilibria allows for the emergence of a new order out of chaos. The structures which create this order cause the system as a whole to once again become stable. The heterogeneity of the individual agents creates differences in transactions by which asymmetry, focal points and norms for behaviour can emerge. Conventions and institutions are structures for interaction which create order in the economy. The use of money is one of these structures. In the money-wage or entrepreneur economy, entrepreneurs cause discontinuities by

creating *Neue Kombinationen*. By doing so, they contribute to new structures in the economy, for instance by creating new product or services markets. The social capital which accumulates by repeated interactions allows for coordination via network structures, as represented by the flexibly coordinated economy of chapter 5. As compared to the statist-hierarchical economy and the contract-based economy, the flexibly coordinated network economy is better able to change and more stable, respectively (*cf.* Lof, 1997). Within the network structure, coordination problems are relatively well dealt with. Given this coordination, further efforts can be put into improving the efficiency of the allocation. For instance, institutions can be fine-tuned by re-regulation processes. Outside the structure, the neutral economy lacks this high degree of coordination, so that agents can only try to allocate as efficiently as they can at their micro level. The economy cannot be expected to reach a high level outcome as long as coordination failures exist.

The open system interpretation of a monetary economy results in a more optimistic view towards its stability, albeit in terms of higher order stability. The concept of general equilibrium is no longer relevant because of the fundamental uncertainty. Still, the monetary economy can reasonably be assumed to self-organize. Conventions and institutions facilitate the coordination necessary to enable the economy to adapt to changed circumstances, such as occur after large shocks, while these norms for behaviour themselves evolve over time, so that the economy can adapt to changing circumstances. The monetary economy can therefore be considered stable as well as resilient. The term 'adaptive'[15] captures the dynamics inherent to an economy which evolves over historical time, as opposed to the static character of money equilibrium models of closed economic systems. Ergo, from an open system approach, it follows that the monetary economy is robust to shocks by grace of its ability to self-organize. By this capacity, it can create new structures which cause the economy to be in a state of order. Thus, the self-

[15] The idea of adaptability as distinct from stability was inspired by Toulmin (1990, p.192) and should not be interpreted as referring to functionalist interpretations of evolution in biology.

organizing economy is able to maintain order, even though its structure may change over time. For instance, new conventions and institutions may evolve.

In order to solve the paradox with respect to the degree of nominal price stickiness, one further step can be made. The corridor-approach suggests that the economy can move in and out of equilibrium. Pictured in the two-dimensional diagram, it looks as if variables can move through a graph, like an exchange rate can be pictured as moving in the EMS-snake-in-the-tunnel. If this were the case, then either the paradox would be resolved at the level of containment, or a horizontal dualism would result, as in Chick's third way of dealing with opposites. However, the open system approach allows for a synthesis. The theory of dissipative structures provides a framework for such synthesis by its suggestion that order emerges out of chaos. This implies that order is not limited to a particular domain of an open system, *cf.* the discussion on boundaries, but refers to a state in which the system can transform itself by means of self-organization. While entropy may increase for a while, at some point a threshold or bifurcation event will occur that will break former symmetry and reinitiate the self-organizing process under the new conditions. In case large displacements occur, threshold effects are invoked, like a process of transition, the structure may break down so that the economy finds itself in a state of chaos again. From this state of chaos, self-organization will initiate itself and a new structure will emerge thanks to the instability of the orderless system. The contents of the corridor evolves over time. Nominal prices can be rather sticky in times of order, while they are likely to become flexible in times of disorder, thereby providing signals which support the formation of new structures. Thus, both views on the benefits and drawbacks of nominal price flexibility discussed at the start of this chapter hold true.

All this leads to the conclusion of this chapter. The Keynesian monetary economy, with all its stickiness and other discontinuities, is more robust, or more stable in a higher order sense, than the otherwise homogeneous, chaotic equilibrium which is described by the neoclassical model of a neutral economy. It is the very fundamental uncertainty and historical time that enable the

unstable, open system to self-organize by means of conventions and institutions, of which the use of money and nominal price rigidity are two examples.

8 Summing Up: Money and Nominal Prices

Can the phenomena of nominal price rigidity or nominal price stickiness be explained from the characteristics of a monetary economy and, if so, how? During the course of the book, this question was analysed from several points of view. The present chapter brings together the main insights, so that an answer to the question can be formulated.

With regard to the characteristics of a monetary economy, two points of view can be distinguished. First, the mainstream economics approach, in which the general equilibrium model is taken as a benchmark. General equilibrium models typically assume a complete set of perfectly competitive markets, which generate and communicate all relevant information on scarcity conditions, so that demanders and suppliers can adjust their relative prices until an equilibrium is attained. The metaphor of a Walrasian auctioneer symbolizes the search for the equilibrium set of relative prices by centralizing the information and transaction decisions. Without such an artificial construct, a decentralized trade process needs to be gone through, which is modelled in general equilibrium search theory. Other strands of mainstream economics explicitly study deviations from the general equilibrium benchmark. For instance, New Keynesian economics tries to underpin real and nominal price rigidites from choice-theoretic principles. Disequilibrium economics analyses the implications of real and nominal price rigidities for the efficiency and stability of the economy. However, an analysis of the implications of nominal price rigidity differs from an explanation of its cause. As long as the general equilibrium remains the benchmark model, assumptions as to the degree of price stickiness are bound to remain *ad hoc* and can at best serve to illustrate the impact of limited price flexibility on the economy. The same can be said with respect to the use of money. In general equilibrium models, money is not essential. Amendments to the model try to incorporate money by introducing *ad hoc* assumptions, such as transaction costs. As these assumptions do not

change the fundamental model of the economy, the amended models cannot serve to analyse the characteristics of a monetary economy.

In order to capture the essence of the monetary economy, an entirely different view on the economic process needs to be taken. Once fundamental uncertainty and historical time are taken into account, any theory which takes the general equilibrium model as a benchmark is useless for two reasons. First, the impact of these two phenomena affects the structure of the model instead of solely setting constraints on its outcomes. One could even say that the monetary economy requires a different kind of analysis. Not only does the starting point of the analysis differ, due to the two assumptions, but the mechanisms by which the economy functions changes as well. Examples of alternative mechanisms are given by the emergence of patterns of behaviour such as conventions and institutions. Opposite to mainstream economics, economic behaviour is no longer assumed to always be directed towards maximum welfare, with the possible result of an equilibrium. It is doubtful whether such thing as an equilibrium even exists in a monetary economy, although this depends on the definition of an equilibrium being used, as was explained in chapter 6. At least, the economic agents are not likely to find it, which raises doubts about the capacity of the modeller to do so (*cf.* Sargent, 1993, Ch.1). Secondly, money is at least as much related to the process of trade as to its outcomes. From general equilibrium theory, the benefits of specialisation in terms of efficiency and welfare can be analysed. However, trade follows from specialisation, and coordination problems are inherent to trade, particularly once fundamental uncertainty exists. Whereas general equilibrium theory is microeconomic in kind, a monetary economy calls for a macroeconomic analysis, in which the problem of coordination is taken seriously (Van Ees and Garretsen, 1990). The concept of historical time, intrinsic to a monetary economy, calls for a dynamic analysis rather than a comparative static analysis, so that processes can be analysed explicitly. Whether or not these processes tend towards any kind of equilibrium is of secondary importance.

More relevant than the attainment of an equilibrium is the issue of

stability of the economic system.[1] Such stability can be described as the ability of an economy to persist while maintaining its fundamental characteristics. Adding a market for money in models in which the economy is otherwise stable creates room for instability. Nominal price adjustments do not result in equally large real adjustments once the price level changes as well, so that an economy may end up in situations of hyperinflation or hyperdeflation. Further, money is only partly a substitute for goods, as the transactions demand for money goes together with the demand for goods. However, once fundamental uncertainty causes agents not to adjust their nominal prices to shocks, some degree of nominal price rigidity results and cumulative processes are less likely to occur. Moreover, this book argues that the stability of the monetary economy is not endangered by fundamental uncertainty and historical time, but supported by it. The argument has interesting analogies to the theory of self-organizing open systems, which stems from chemistry. This theory reveals that open systems, with fundamental uncertainty and historical time being among their characteristics, are able to reduce chaos and create structure. The degree of chaos, or entropy, is reduced and order emerges out of chaos. If the system were closed, as in most of the economic models, this outcome could not occur. In closed systems, order may occur if hierarchy is introduced in the system: the Walrasian auctioneer or a benevolent dictator who summons equilibrium prices. However, these organizing principles clearly differ from self-organization. In chemistry, hierarchy is impossible, as molecules are the entitities in the system. Therefore, if order emerges in a chemical system, it must be a bottom-up process. Chapter 4 already argued that the emergence of institutions, and even more conventions, is a bottom-up process of ordering as well. The analogy with chemical systems underpins the notion that such bottom-up processes can secure stability of the open system. Thus, the analysis of a monetary economy calls for an open systems approach for two reasons: first, because only open systems analysis can adequately deal with the two

[1]Stability of the system should not be confused with stability of any equilibrium (see chapter 7).

fundamental characteristics of a monetary economy, and second, because the behaviour of open systems under such conditions is a better representation of processes in a monetary economy. Fundamental uncertainty causes agents to behave predictably and to form their expectations upon predictable behaviour by others. If they would act instrumentally rational, their infinite degree of flexibility would make their behaviour highly unpredictable. Instead, by following rules for behaviour, agents create patterns of interactions. For instance, they agree on a particular money and legally protect this money in order for it to function properly. Further, the agents comply with formal rules or informal conventions on price setting behaviour, such as rules on the timing of price changes or the kind of shocks which make them adjust their prices. Another example is the general agreement on the intervals of wage adjustments. Together, these conventions and institutions constitute the social capital of an economy which contributes to its stability. Government regulation can support this social capital, but destroy it as well. Once government policy is focused upon increasing the domain of competitive markets, with the aim of increasing efficiency, it will tend to deregulate as much as possible. However, the attainment of efficiency can go at the expense of coordination, so that the economy is worse off. A situation of coordination failure may be the result, with low levels of production and employment.

In order to take the issue of coordination seriously, a macro foundation of microeconomics is called for. Macroeconomics, or the economics of coordination, explicitly analyses the interaction between agents. By implication, the assumption of a representative agent cannot be made (Van Ees and Garretsen, 1990). Again, this difference with the standard model is not problematic, but beneficiary. The heterogeneity of agents may make them differ in the expectations they form and the actions they take. Thanks to heterogeneity, structure can be created. For instance, heterogeneous agents seldomly want to buy or sell all at the same time, so that trade can continue and prices remain stable. Cumulative causation is less likely to occur, although speculative bubbles and trade cycles cannot be ruled out. Moreover, in terms of coordination games, the game is less likely to be symmetric, so that

conventions and institutions easier come into existence. All agents play their unique roles in the economy, thereby causing structures of interaction to emerge which stabilize the economy. All in all, an economics which solely relies on a choice theoretic paradigm would be incomplete. What is needed is an additional coordinating assumption (Leijonhufvud, 1992, p.26). Instead of the usual assumption of competitive markets, which is not a very realistic one, the emergence and existence of conventions and institutions can be seen as a coordinating device. The metaphor of an auctioneer can be dismissed once economic theory takes the above implications of fundamental uncertainty, irreversibility, and heterogeneous agents seriously.

Going back to the topic of the use of money and nominal price rigidity, the following conclusions can be drawn. In case one considers the question as to "whether the price mechanism may ensure a degree of coordination that leads to full employment" as "the central theme of the theory of the economy as a whole" (Van Ees and Garretsen, 1990, p.141) the answer tends to be positive, but the mechanism is more important. Whereas mainstream economists consider the price mechanism able to do so thanks to the flexibility of relative prices, the present argument states that some degree of nominal price stickiness makes the economy able to attain a coordinated outcome. It is not sure whether this coordinated outcome is a high employment outcome, but it is sure that a non-coordinated outcome is not, as mismatches result in production below capacity. Therefore, the contribution of the use of money and nominal price rigidity to coordination in the monetary economy, are likely to be positive with respect to the level of employment. The interdependencies of decisions in a monetary economy with fundamental uncertainty make the formation of expectations difficult. Nominal price rigidities make price setting behaviour better predictable, because the agents can base their decisions upon information on the behaviour of others.

Money facilitates the process by the three functions it performs. First, a convention on the means of exchange facilitates its acceptance in transactions. The use of a means of exchange solves the problem of the double coincidence of the timing of wants and thereby improves efficiency. Secondly, as a unit of

account, money facilitates calculation and comparison, so that agents can cheaply find favourable terms of trade. Moreover, the use of a common unit of prices meets the limited capacity of agents to process and store information and it provides price setters with a means of communicating their commitment to a customer relationship. Thanks to nominal price rigidity, the price level can be rather stable so that the unit of account can function properly. Thirdly, the store of value function of money is made possible by the institution of a central bank which secures the integrity of the money and a government which punishes forfeiters. The convention of accepting money in payment makes money the most liquid store of value, which contributes to its value even if no interest is paid on it. By the three functions money performs, it contributes to order in the decentralized exchange economy.

Money and nominal price rigidity both stem from the characteristics of a monetary economy, those being fundamental uncertainty and historical time. They are both important manifestations of the conventions and institutions in a monetary economy. To some extent, they are related directly. To another, their relation stems from their common source. Therefore, the connection between the two phenomena and their common source, being the characteristics of the monetary economy, can best be visualized as a triangle.

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Samenvatting

Dit proefschrift beoogt een verklaring te bieden voor het bestaan van nominale prijsrigiditeiten die gebaseerd is op de kenmerken van een monetaire economie. Met andere woorden, de vraag wordt beantwoord in hoeverre en op welke wijze de beperkte flexibiliteit van nominale prijzen samenhangt met het feit dat deze in termen van geld worden uitgedrukt. Alvorens in te gaan op deze samenhang, worden de fenomenen geldgebruik en nominale prijsrigiditeit[1] afzonderlijk geanalyseerd. Uit beide analyses komen coördinatieproblemen als een essentieel onderdeel van een monetaire economie naar voren. Uit een theoretische verhandeling over coördinatieproblemen wordt afgeleid dat zowel geldgebruik als prijszettingsregels kunnen worden geïnterpreteerd als conventies en instituties die coördinatieproblemen helpen oplossen. In de laatste hoofdstukken wordt geargumenteerd dat dergelijke gedragsregels de stabiliteit van de economie vergroten. Deze conclusie, die ongebruikelijk is in de gangbare economische theorie, wordt vergeleken met een theorie uit de scheikunde, die tot hetzelfde inzicht leidt. In het hiernavolgende worden de bovenstaande stappen hoofdstukgewijs uitgewerkt.

In **hoofdstuk 1** wordt de probleemstelling ingeleid en ingebed in de literatuur. De meeste theorieën met betrekking tot nominale prijsrigiditeit gaan uit van nominale prijzen als zijnde de geldwaarde van een goed zonder het gevolg van het gebruik van geld voor het functioneren van de economie als zodanig in beschouwing te nemen. In dit proefschrift wordt daarentegen betoogd dat een monetaire economie fundamenteel verschilt van een reële economie. Het feit dat geld intrinsiek verschillend is van andere goederen en dat een monetaire economie fundamenteel

[1] Nominale prijsrigiditeit ontstaat wanneer prijszetters in een markt het aanpassen van hun prijzen niet winstgevend achten, gegeven dat andere prijzen onveranderd blijven. Ingeval veel prijszetters er zo over denken, ontstaat een tamelijk stabiel algemeen prijspeil.

verschilt van een standaard leerboek-economie, leidt tot implicaties die verder reiken dan het vraagstuk van de neutraliteit van geld suggereert. Historische tijd en fundamentele onzekerheid, zijnde de determinanten van een monetaire economie, beïnvloeden de manier waarop agenten beslissen en de wijze waarop de beslissingen van alle agenten resulteren in macro-economische uitkomsten. Eén van die uitkomsten is nominale prijsrigiditeit of, in elk geval, nominale prijsstarheid. De manier waarop agenten kiezen en handelen in een economie met historische tijd en fundamentele onzekerheid leidt zowel tot het gebruik van geld als tot het optreden van nominale prijsstarheden. Beide fenomenen kunnen worden gezien als conventionele en geïnstitutionaliseerde gedragsregels die de interacties in een economie structureren. Op deze wijze zijn de twee fenomenen van geld en nominale prijsstarheid indirect gerelateerd door hun gemeenschappelijke oorzaak, zijnde fundamentele onzekerheid en historische tijd. Ze zijn tevens direct gerelateerd door het argument dat de stabiliteit van een monetaire economie een stabiel prijspeil vereist om aldus de koopkracht van geld te handhaven, alsmede het feit dat nominale prijzen geld vergen als eenheid waarin zij worden uitgedrukt.

De literatuur op het gebied van de theorie van het geldgebruik wordt in **hoofdstuk 2** geanalyseerd opdat conclusies over de kenmerken van een monetaire economie kunnen worden getrokken. De theorie van Arrow en Debreu dient als uitgangspunt, omdat geld in hun algemene-evenwichtsmodel irrelevant is, zodat kan worden onderzocht wat de minimale kenmerken zijn van een economie waarin het gebruik van geld invloed heeft op de essentiële kenmerken van het economische systeem. Vervolgens worden diverse (pseudo-)monetaire modellen besproken. De drie functies van geld, namelijk ruilmiddel, rekeneenheid en oppotmiddel, worden gebruikt als criteria om de modellen te beoordelen op hun mogelijkheid het gebruik van geld te incorporeren en te verklaren. Drie groepen modellen worden besproken. De eerste groep bestaat uit statische en dynamische algemene-

evenwichtsmodellen. Het model van Arrow en Debreu en de metafoor van de veilingmeester van Walras vormen het statische gedeelte van de groep, terwijl het dynamische gedeelte wordt gevormd door het temporele-evenwichtsmodel en het model van de overlappende generaties. De tweede groep wordt gevormd door modellen uit de zoektheorie. Deze groep van modellen wordt afzonderlijk behandeld, omdat hierin expliciet aandacht wordt besteed aan de wijze waarop geld als ruilmiddel kan bijdragen aan coördinatie in het proces van gedecentraliseerde ruil. Hierdoor zijn zoektheoretische modellen de verst ontwikkelde algemene-evenwichtsmodellen met betrekking tot het gebruik van geld. In sommige zoektheoretische modellen wordt geld gepostuleerd als het goed met de laagste (of dat geheel zonder) transactiekosten. Echter, ook in zoektheoretische modellen waarin het gebruik van geld endogeen is, wordt de keuze tussen het monetaire evenwicht en één of meerdere ruilevenwichten niet binnen het model bepaald. Derhalve zal, om te onderbouwen dat een keuze voor het evenwicht met de laagste transactiekosten wordt gemaakt, in casu het monetaire evenwicht, additionele informatie van buiten het model nodig zijn. De derde groep van modellen bestaat uit alternatieve verklaringen voor geld welke alle uitgaan van fundamentele onzekerheid. De theorie van de kredieteconomie, de notie van geld als buffervoorraad en de Post Keynesiaanse theorie leveren complementaire inzichten op over de implicaties van fundamentele onzekerheid voor het functioneren van een monetaire economie. Bovendien blijkt historische tijd een relevante factor, omdat hiermee de onomkeerbaarheid van transacties wordt bepaald, hetgeen de invloed van onzekerheid op ruiltransacties versterkt. Aldus zijn twee essentiële kenmerken van een monetaire economie geïdentificeerd. De conclusie van dit hoofdstuk luidt dat fundamentele onzekerheid en historische tijd voorwaarden zijn voor het ontstaan en functioneren van een monetaire economie.

In **hoofdstuk 3** worden diverse soorten theorieën met betrekking tot

nominale prijsrigiditeit onderzocht. Uitgaande van markten met volledig vrije mededinging als referentiekader moeten enkele aanvullende veronderstellingen worden gemaakt om van het bij deze modellen behorende prijsnemende gedrag naar prijszettingsgedrag te komen. De Nieuw-Keynesiaanse theorieën veronderstellen onvolledige mededinging, doch behouden de veronderstelling van instrumentele rationaliteit in termen van winstmaximaliserend gedrag. Vanuit dit raamwerk kan het niet altijd aanpassen van prijzen aan gewijzigde omstandigheden worden gerationaliseerd door een kosten-batenanalyse van prijsaanpassingen te maken. Sommige van deze theorieën hebben uitsluitend betrekking op individuele prijszettingsbeslissingen, zoals de menukostenbenadering; andere theorieën behandelen ook coördinatieproblemen, zoals de theorie over meervoudige evenwichten bij prijszetting. Naast of in plaats van het gebrek aan informatie met betrekking tot marktvariabelen waarmee in modellen van individueel prijszettingsgedrag reeds rekening wordt gehouden, veronderstellen theorieën over coördinatieproblemen dat informatie omtrent het gedrag van andere agenten niet beschikbaar is. Daarentegen wordt in de modellen van op kosten gebaseerde prijszetting en *mark-up*-prijszetting het referentiepunt van volledig vrije mededinging in het geheel niet gebruikt. Deze theorieën gaan dieper in op de gevolgen van onvolledige mededinging door de implicaties ervan op de prijszettingsbeslissingen te beschouwen. In de theorieën over *mark-up pricing* en *administered prices* hebben prijzen meerdere functies naast het in evenwicht brengen van vraag en aanbod, zoals het goedmaken van productiekosten en het behouden van de vigerende marktstructuur. Dit kan tot gevolg hebben dat hoeveelheidsrantsoenering optreedt. Nominale prijsrigiditeiten kunnen worden gezien als een middel om prijszettingsbeslissingen te coördineren, zodat rigiditeit als een positieve eigenschap van nominale prijzen kan worden beschouwd, hetgeen onmogelijk zou zijn ingeval het referentiekader van volledig vrije mededinging zou zijn gehanteerd. Andere, minder formele theoriën bouwen voort op de notie dat de

wijze waarop prijzen worden gezet kan bijdragen aan het versterken van relaties tussen vragers en aanbieders, zoals in bedrijfsmatige koper-verkoperrelaties veel voorkomt en voor consumenten in de theorie van de klantenmarkten wordt uitgewerkt. Tevens kunnen prijzen worden beschouwd als dragers van informatie met betrekking tot de intentie van degenen die een transactie willen aangaan. Het hoofdstuk eindigt met het aanhalen van enkele onderzoeken welke erop duiden dat in de werkelijke wereld noties als eerlijkheid, rechtvaardigheid en vertrouwen veelal een belangrijkere rol bij prijszetting spelen dan formele modellen laten zien.

Hoofdstuk 4 begint met een formele speltheoretische interpretatie van coördinatieproblemen die in een economie voorkomen. Drie soorten spelen worden geanalyseerd, waarin de mate waarin coördinatie en conflict een rol spelen, varieert. Er wordt aangetoond dat speltheoretische technieken voor het selecteren van een evenwicht of het bereiken van de uitkomst met de hoogste opbrengst niet altijd voldoende zijn, waardoor de behoefte aan extra informatie van buiten het spel ontstaat. Zelfs als spelers alles weten behalve de acties van hun medespeler(s), kan het coördinatieprobleem niet altijd worden opgelost. Normen kunnen in deze informatiebehoefte voorzien. Normen zijn gedragsregels die de vorm kunnen aannemen van conventies en instituties, of informele versus formele instituties, afhankelijk van de vrijwilligheid of dwang aan de gedragsregels te voldoen. Het ontstaan en voortbestaan van normen, alsmede het verband tussen typen normen en soorten coördinatieproblemen komen aan de orde. Hierbij ontstaat een evolutionaire benadering van gedragsregels, welke mogelijk wordt gemaakt door het uitgangspunt van historische tijd als kenmerk van de monetaire economie. Het verband tussen conventies en rationaliteit wordt uitgewerkt, waarbij het gangbare begrip van instrumentele rationaliteit wordt vervangen door de notie van procedurele rationaliteit. Op deze formele speltheoretische benadering van gedragsregels kan de benadering van de institutionele economie als complement

worden beschouwd. Hierbij worden transactiekosten en gedragstheorieën in beschouwing genomen om het bestaan van conventies en instituties te onderbouwen. Voorbijgaand aan verschillen tussen de diverse stromingen binnen de institutionele economie worden op eclectische wijze diverse inzichten aangehaald om de analyse te onderbouwen. De combinatie van speltheorie en institutionele economie levert een analytisch raamwerk op waarbinnen conventies en instituties kunnen worden gezien als middelen om de coördinatieproblemen op te lossen die ontstaan ten gevolge van het bestaan van fundamentele onzekerheid. De conventie van het geldgebruik en de instituties eromheen, alsmede de conventies en instituties met betrekking tot nominale prijsrigiditeit structureren de interactie tussen individuele agenten, waardoor handelstransacties mogelijk worden gemaakt.

Een belangrijk element bij het aangaan en onderhouden van handelsrelaties is vertrouwen. Vertrouwen en gewoonte vervullen een belangrijke rol in het functioneren van conventies en instituties, maar vallen buiten het rationaliteitsbegrip. Gewoontes kunnen relatief eenvoudig in het theoretische raamwerk worden opgenomen, doordat het fenomeen 'herhaald gedrag' onderdeel uitmaakt van de evolutionaire benadering die in het vorige hoofdstuk is ontwikkeld. Het begrip 'vertrouwen' dient separaat te worden beschouwd, hetgeen in hoofdstuk 5 gebeurt. In **hoofdstuk 5** wordt de implicatie van vertrouwen voor economische relaties, in het bijzonder relaties bij geldtransacties, onderzocht. Het begrip vertrouwen wordt nader onderzocht opdat het kan worden gereduceerd tot hetgeen er essentieel aan is. Hieruit blijkt dat twee aspecten van vertrouwen relevant zijn, te weten een informatieaspect en een normatief aspect. Tevens blijkt dat vertrouwen op twee niveaus kan worden geanalyseerd, namelijk het bilaterale niveau en het sociale niveau. Beide niveaus zijn relevant voor het analyseren van het gebruik van geld en nominaal prijszettingsgedrag. Het informatieaspect laat

zich het eenvoudigst in de bestaande economische theorie opnemen. Hierbij kan vertrouwen deels worden gezien als complement van informatie en deels als substituut ervoor, als het ware als een bron van subjectieve informatie. Deze benadering is echter incompleet: ingeval agenten erop kunnen vertrouwen dat ze zich geen van allen aan gemaakte afspraken zullen houden hebben ze veel informatie over elkaars gedrag, maar is het resultaat voor de economie slechter dan in de situatie waarin agenten erop kunnen vertrouwen dat ze zich allen eerlijk en coöperatief zullen gedragen. In termen van coördinatieproblemen komt de coördinatieuitkomst met hoge opbrengst binnen bereik indien agenten in een economie een gezamenlijke waardenverzameling delen, zijnde de gedragsregels die in het vorige hoofdstuk cruciaal zijn gebleken. Tevens kan worden betoogd dat indien er veel onderling vertrouwen in een economie aanwezig is, agenten eerder geneigd zullen zijn risico's te nemen, zodat nieuwe ondernemingen en investeringen tot stand komen. Bovendien behoeven contracten niet meer zo volledig mogelijk te zijn, hetgeen de transactiekosten verlaagt. Dit hoofdstuk onderbouwt dan ook de resultaten van het vorige: gedeelde ethische normen bieden een richtpunt in coördinatieproblemen en voorkomen ondermijnend gedrag in situaties met conflicterende belangen.

In **hoofdstuk 6** worden de inzichten uit vorige hoofdstukken samengenomen en gebruikt om terug te keren naar de kernvraag van het proefschrift: het verklaren van het optreden van nominale prijsrigiditeiten in een monetaire economie. Het bestaan van zowel onzekerheid als historische tijd resulteert in coördinatieproblemen met betrekking tot het ruilproces en de prijszettingsbeslissingen. Er wordt gesteld dat deze beide problemen worden opgelost op twee complementaire manieren, namelijk van boven naar beneden en van beneden naar boven. Coördinatie van boven af, welke kan plaatsvinden met behulp van instituties zoals een centrale bank of een overheid, is inefficiënt en erg

kostbaar ingeval enkel deze instituties prijsstabiliteit dienen te bewerkstelligen. Bovendien is het hoogst onwaarschijnlijk dat de hiervoor benodigde informatie op gecentraliseerd niveau aanwezig is. Gelukkig draagt de manier waarop decentrale ruil plaatsvindt bij aan coördinatie van onderen af. De manier waarop agenten omgaan met onzekerheid resulteert in coördinatie en heeft het onbedoelde positieve neveneffect tevens bij te dragen aan prijsstabiliteit. Conventies en instituties worden bewust en onbewust opgebouwd, bij voorbeeld door het aangaan van impliciete en expliciete contracten en het impliciet of expliciet overeenkomen niet prijzen maar hoeveelheden aan te passen. De importantie van vertrouwen wordt duidelijk als overwegingen van rechtvaardigheid in prijszetting een rol spelen. Conventies en instituties maken de economie stabieler dan standaard economische modellen voorspellen: net als in pure coördinatiespelen doen echte individuen het beter dan hun gemodelleerde evenbeelden. Dit effect van onvoorspelde stabiliteit is mogelijk doordat geld een rol vervult als informatiedrager, waardoor gedragsregels kunnen worden gevolgd en versterkt. Het feit dat agenten rekenen in termen van geld wordt relevant indien de implicatie dat zij ook in termen van geld communiceren wordt onderkend. Het resultaat is een model van een monetaire economie dat wezenlijk afwijkt van het Walrassiaanse model waarmee dit boek startte en waarin geld niet meer is dan 'het n-de goed'. Niet alleen de hoeveelheid van het oppotmiddel is nu van belang, maar ook de kwalitatieve eigenschappen van het meest liquide activum zijn relevant. De Keynesiaanse entrepreneur-economie is nu onderbouwd door de analyse van conventies en instituties eraan toe te voegen, welke een stabiliserende rol spelen. Coördinatiegeoriënteerde strategieën op individueel niveau hebben een stabiliserende uitwerking welke kan worden gezien als een onbedoeld gevolg van handelingen die daardoor gunstig zijn voor de economie als geheel.

Hoewel de onderzoeksvraag van het boek hiermee is beantwoord, kan nog

meer worden gezegd over de bijdrage van gedragsregels aan het stabiliseren van de monetaire economie. In **hoofdstuk 7** is de corridor-benadering van Leijonhufvud (1981) het vertrekpunt voor een beschouwing over stabiliteit van systemen. Het begrip stabiliteit heeft meestal betrekking op evenwichten en is in die hoedanigheid een veel voorkomend begrip in modellen van gesloten systemen. Analyses van open systemen geven aan dat een systeem zichzelf kan ordenen. In dit hoofdstuk wordt de analogie van open systemen in de natuurwetenschappen en het huidige economische raamwerk onderzocht. Oorspronkelijk beperkte het inzicht in de natuurwetenschappen zich tot de wetmatigheid dat gesloten systemen tenderen naar toenemende entropie, waardoor zij vroeg of laat eindigen in een homogene, chaotische toestand. Sinds de theorie van de dissipatieve structuren, afkomstig van Nobelprijswinnaar Ilya Prigogine, is bekend dat in open systemen een entropiegrens bestaat. Wanneer een open systeem een bepaald niveau van entropie heeft bereikt, gaat het zichzelf ordenen door patronen van gedrag en interactie van de individuele eenheden van het systeem. De dissipatieve structuren in de chemie worden gekenmerkt door een hoge mate van ordening, dat wil zeggen dat zij een locale reductie van entropie bewerkstelligen. Analoog aan chemische processen, die in feite een serie van interacties tussen moleculen zijn, kan de economie worden gezien als een zelf-organiserend systeem van interacterende agenten. In een economisch systeem structureren conventies en instituties het gedrag van interacterende agenten, waardoor ordening ontstaat. De analogie met de theorie van dissipatieve structuren suggereert zelfs dat een economie in staat is tot zelf-organisatie *dankzij* fundamentele onzekerheid en historische tijd. Deze conclusie staat haaks op die van de neoklassieke economie, waarin een monetaire economie stabiel kan zijn *ondanks* beide kenmerken, voorzover de kenmerken als zodanig niet reeds strijdig zouden zijn met de neoklassieke economie. Dankzij conventies en instituties kan stabiliteit van een hogere orde ontstaan, dat wil zeggen dat de economie robuust is in het reageren op schokken. De economie kan zichzelf

opnieuw ordenen nadat schokken de oude structuren onbruikbaar hebben gemaakt. In het herstructureren speelt de evolutie van conventies en instituties een belangrijke rol.

Hoofdstuk 8 vormt de conclusie van het boek. Het verzamelt de nieuwe inzichten die uit de argumentatie voortkomen en beziet daarmee nogmaals het vraagstuk van nominale prijsrigiditeiten in een monetaire economie.

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